APPENDIX A

ENGINEERING DESIGN AND COST ESTIMATE
BROWARD COUNTY, FLORIDA SHORE PROTECTION PROJECT
GENERAL REEVALUATION REPORT
SEGMENT II

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PROJECT AUTHORITY

A-1. House Document 91/89/1 (USACE, 1963) describes the erosion along Broward County's shoreline. The Broward County erosion control project was authorized by the River and Harbor Act of 1965 (PL 89-298). The problem area identified between the Hillsboro Inlet to Port Everglades segment was 3.0 miles long, and had as its north limit 2,000 feet south of Hillsboro Inlet (R-31 + 650 ft.) and its south limit approximately 2,500 feet south of the Pompano Beach city limits (R-48 + 700 ft.). The original plan did not recommend restoration of the beaches south of this project area, although it recommended periodic nourishment for the remainder of the reach on an as needed basis.

PROBLEM IDENTIFICATION

A-2. The authorized project calls for a 75 to 125 foot extension of the ECL in Pompano Beach and Lauderdale-by-the-Sea. The present shoreline breaches this design width and the present nourishment interval has lapsed. While Ft. Lauderdale's beaches experience lower erosion rates than Pompano Beach and Lauderdale-by-the-Sea, the beach now requires periodic nourishment. The objectives of this appendix include quantification of existing erosion problems and the design of corrective measures. Quantification efforts involved analysis of historical shoreline positions, estimates of alongshore transport rates, predicted cross-shore processes due to storms, and equilibrium profile response. The results of these efforts constitute the basis of design of the renourishment for Pompano Beach/Lauderdale-by-the-Sea and for the extension of the project into Ft. Lauderdale.

PROJECT LOCATION

A-3. Segment II of the Broward County Shore Protection Project is located 23 miles north of Miami Beach on the southeastern coast of Florida. This segment of the Broward County Federal project consists of 11.3 miles of Atlantic Ocean shoreline from Hillsboro Inlet south to Port Everglades Inlet (Figure A-1). The segment is located on a barrier island entirely within Broward County. The municipalities within the segment include Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, and Ft. Lauderdale. For purposes of analyses presented in this appendix, the segment is subdivided into reaches (Figure A-1).

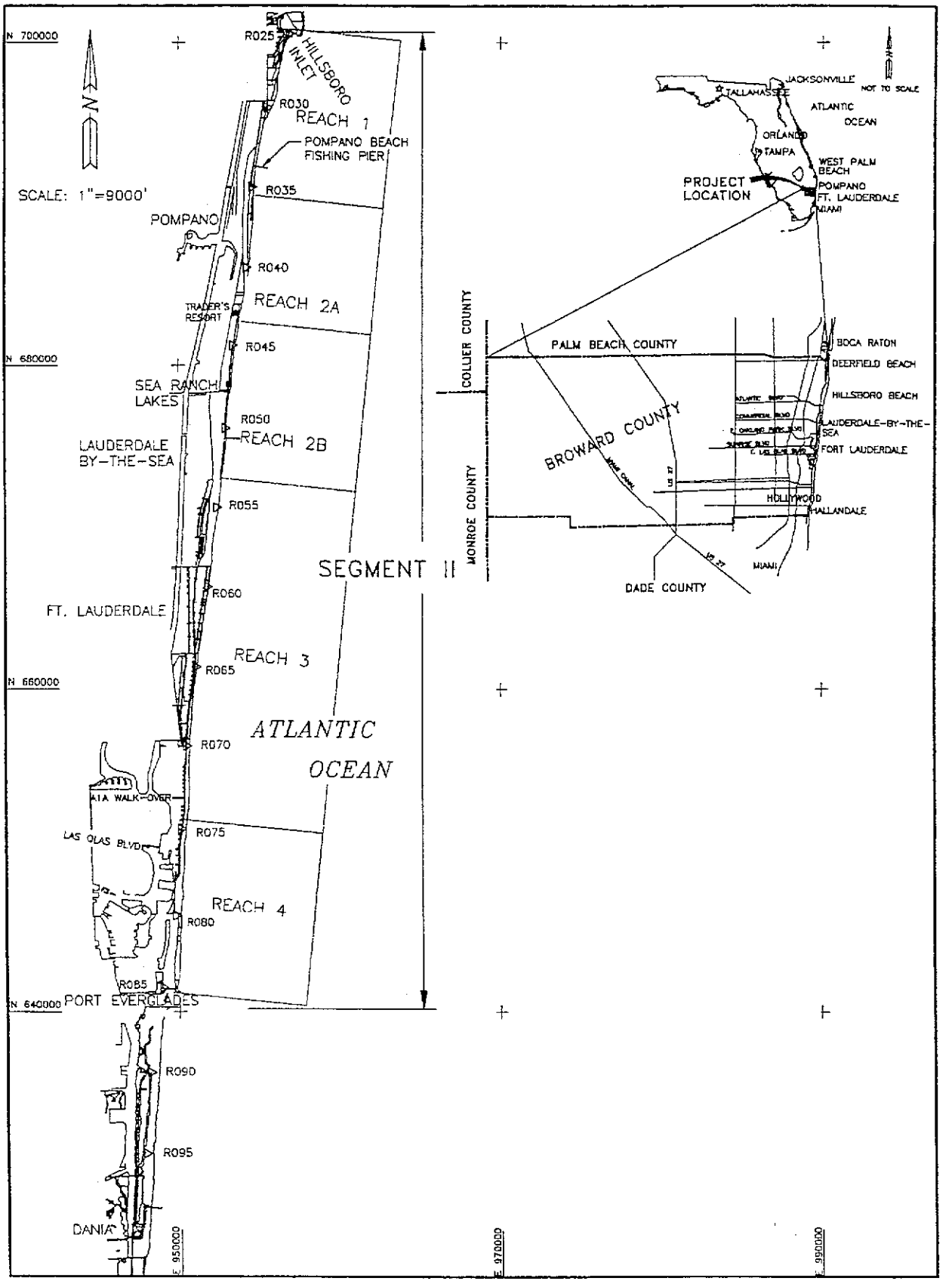


FIGURE A-1

PROJECT LOCATION MAP

NATURAL FORCES

WINDS AND TIDES

A-4. Local winds are the primary generating mechanism of short period waves in the project area. Typical prevailing winds are from the east through the southeast. During winter months (December through March), winds are often out of the northwest and north. Low pressure cold fronts generally traverse the continental United States from west to east. Severe storms associated with these fronts can cause extensive beach erosion and shorefront damage. The summer months (June to September) are characterized by tropical weather systems traveling east to west in the lower latitudes. These tropical systems can develop into tropical storms and hurricanes, which can generate devastating winds, waves and storm surge. Southeast tradewinds make up the typical summer wind climate.

A-5. Daily onshore-offshore breezes associated with the differential heating of land and water masses are common within the study area. While these breezes play a significant role in local weather patterns, they are not an appreciable cause of sediment movement in the nearshore area.

A-6. Tides in the project area are primarily semi-diurnal. The mean tidal range for Segment II is 2.6 feet.

NEARSHORE CURRENTS

A-7. The primary currents in the nearshore region are wave-induced longshore currents. These currents are driven by the transformation of obliquely incident waves in the surfzone. The magnitude of the longshore current is generally greatest in the region immediately landward of the point of depth-induced wave breaking, and is primarily a function of the local wind and wave climate. The longshore currents are primarily from north to south. There have been no direct measurements of wave-induced longshore currents in Segment II.

WAVES

A-8. The waves experienced in Broward County are primarily caused by local wind patterns, although some long-period swells from more distant northeast and east events are observed during winter months. The proximity of the Great Bahama Banks to the South Florida coast prevents the development of large waves from the southeast. The largest waves reaching Broward County arrive from the northeast and east. Many of these larger waves are typically generated in weather disturbances far off in the North Atlantic Ocean, while some of the northeast wave climate is caused by frontal winds. The more regular eastern wave set is generated by the daily onshore-offshore breeze discussed earlier. These shore-perpendicular waves, although frequent, are not large because of the short duration of the driving winds. The frequency of waves from the southeast (20%) is largely caused by the summer prevailing tradewinds. These winds are the primary driving force behind the northward littoral drift thought to occur during the summer months. The remaining waves recorded at Broward County are predominantly the result of frontal activity.

A-9. The principal forcing mechanism behind beach erosion is the dissipation of energy (and corresponding transport of sand) as waves transform in the nearshore. Wave height, period, and direction as well as the water level during storm events are the most important factors influencing the project shoreline. Since the 1980's, the U.S. Army Engineer, Waterways Experiment Station's Coastal Engineering Research Center has executed a series of wave hindcast studies for the Atlantic and Gulf Coasts of the United States. The 20-year long hindcasts used in this study represent conditions that existed between 1976 and 1995. For this investigation, hindcast results compiled in WIS Report 33 (Brooks and Brandon, 1995) were used. This updated hindcast includes wave information for both extratropical storms and tropical cyclones.

A-10. The wave statistics used for this analysis were obtained from Station A2010 (WIS Report 33) located at latitude 26.25° N and longitude 80.0° W. This station is roughly 10 miles offshore, where the waves are deep water waves. Tables A-1 to A-3 summarize the hindcast wave results for Station A2010. Table A-1 is a summary of the mean significant wave by month and year for the 20-year period. This table is useful in showing the distribution of wave height throughout the year. Table A-2 shows the largest significant wave height and period by month and year. The percent occurrence of wave height and period for all directions is shown in Table A-3.

YEARLY DEPTH LIMIT

A-11. For natural sand beaches, a useful coastal processes parameter is the yearly depth limit of the active nearshore profile. This is also referred to as the depth of closure (DOC). Beyond this depth only negligible sand movement is expected. Hallermeier (1978) has developed a procedure for estimating the depth of closure, d_c. This depth is based on the approximate extreme wave condition for nearshore significant waves, and may be calculated by:

$$d_c = 2.28\ H_e - 68.5\ (H_e^2 / gT_e^2)$$

where:

H_e = nearshore extreme significant wave height (in meters)
T_e = nearshore extreme significant wave period (in seconds)
g = acceleration of gravity constant, 9.81 m/sec.^{2}

A-12. The extreme nearshore significant wave height, H_e, is defined as the "effective" wave height, which has a 0.137% probability of occurring. This wave height is related to the deep water mean wave as follows (Dean & Dalrymple, 1996):

$$H_e = H_{mean} + 5.6\sigma$$

where σ is the standard deviation of annual wave data (in meters).

A-13. The mean wave height, from the WIS hindcast data (Table A-2), is 1.0 m and the standard deviation is 0.6 m. The nearshore extreme significant wave period used is the wave period

Table A-1

Wave Height (in meters) by Month and Year (WIS Station A2010)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1976	1.3	1.1	1	1	0.9	0.7	0.4	0.7	0.5	1.4	1.3	1.5	1
1977	1.2	1	1.1	1.5	0.9	0.4	0.5	0.9	0.6	1	1.4	1.2	1
1978	1.2	1.3	1.1	0.9	0.7	0.6	0.6	0.5	0.8	1.5	1.3	1.5	1
1979	1.7	1.3	1.4	1.4	1	0.8	0.6	0.5	1.4	0.9	1.6	1.4	1.2
1980	1.1	1.5	1.2	0.9	0.8	0.6	0.4	0.8	0.6	0.9	1.4	1.3	1
1981	1	1.7	1.5	1	0.7	0.7	0.5	0.8	0.9	1.1	1.2	1	1
1982	1	0.9	1	0.8	0.9	0.7	0.4	0.5	0.7	1.1	1.2	1.2	0.9
1983	0.9	1.5	1.2	1.1	0.9	0.6	0.5	0.5	1	1.2	1	1.4	1
1984	1.7	1.2	1.2	1	1.1	0.7	0.6	0.5	1.2	1.5	1.8	1.3	1.1
1985	1	1.4	1.1	1.1	0.6	0.5	0.5	0.7	1.4	1	1.4	1.3	1
1986	1.3	1	1.5	0.9	1.1	0.6	0.4	0.8	0.9	1.1	1.2	1.4	1
1987	1.3	1.1	1.7	0.9	0.9	0.6	0.6	0.6	0.5	1.3	1.3	1	1
1988	1.4	1.1	1	0.9	0.8	0.8	0.6	0.5	0.9	1	0.9	0.9	0.9
1989	0.9	1	1.1	0.8	0.6	0.6	0.4	0.5	0.8	1	0.7	0.9	0.8
1990	0.9	1.3	1.2	1.1	0.8	0.6	0.6	0.4	0.7	1	1.1	1.1	0.9
1991	0.9	1	1	1	0.9	0.6	0.4	0.5	0.6	1.1	1.1	1	0.9
1992	1	0.9	0.9	1	0.8	0.6	0.6	0.6	0.7	1	1.4	1.1	0.9
1993	1.3	1.2	1.3	1.1	1	0.7	0.4	0.6	0.7	0.8	1.3	1.1	1
1994	1.4	1.2	1	1.1	0.8	0.6	0.7	0.7	0.8	1	1.3	1.3	1
1995	1	1	1.3	0.9	0.8	0.7	0.6	1	0.9	1.3	1.1	1.1	1
MEAN	1.2	1.2	1.2	1	0.8	0.6	0.5	0.6	0.8	1.1	1.3	1.2	

Table A-2

Largest Wave Height (in meters) by Month and Year (WIS station A2010)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1976	3.9	3.6	3.7	2.7	3.1	1.2	0.8	2.1	0.9	3.7	3.2	3.9
1977	2.5	2.3	3.4	4.1	2.9	1.2	1.1	2.5	2.1	2.5	4.2	3.2
1978	3.2	3.7	3.2	2.6	2.5	3.2	1.9	1.3	1.7	4.2	3.5	5
1979	5.6	2.8	4.4	4.2	2.5	2.8	2.6	1.2	7.3	2.8	4.1	3.7
1980	2.7	4.4	2.9	2.8	2.2	1.8	1.4	4.6	1.4	2.1	3.4	3
1981	3.4	4.8	3.2	3.4	1.8	1.7	1.4	4.1	1.6	3	3.2	2.6
1982	3	2.7	4.1	2.5	1.8	2.7	1.7	1.2	1.2	2.7	3.2	3.1
1983	2.7	4.3	5.2	3.2	2.1	1.2	1.9	2.7	2.9	3.6	3.3	5.1
1984	6.4	3.4	4	2.1	2.9	1.8	1.3	2.3	5.1	3	5.1	3.4
1985	3	4.1	4.1	3.9	1.3	1.9	4	2.2	3.6	2.4	6.2	3.8
1986	4.7	3.3	4	2.1	2.5	1.5	1.3	2.1	1.9	3.6	3.1	4.1
1987	4.7	2.8	5.2	2.2	3.4	2.6	1.6	1.4	0.9	3.3	3.4	3.3
1988	4	2.6	2.3	2.5	2.1	2.9	1.4	2	3.4	2.4	2.5	2.1
1989	2.3	2	3.7	1.4	1.8	1.1	0.9	1.8	2.2	2.4	1.6	2
1990	2.2	3.1	3.4	2.6	1.9	1.2	1.4	0.9	1.1	2.4	3.4	3.5
1991	2.6	2.1	3.3	2.5	3.5	1.7	1	1.3	1.7	2.8	2.2	4
1992	2.5	1.8	2.7	2.7	1.6	1.3	1.1	6.1	1.3	3	3.1	2.1
1993	3.9	2.5	5.1	2.5	2	1.8	0.9	1.6	2.1	2.8	2.3	3.5
1994	3.1	4	3.6	2	2.7	1.2	1.4	1.5	1.6	2.8	5.7	3.6
1995	3.1	1.8	2.8	1.9	1.3	1.9	2.6	4.6	1.4	2.7	1.9	2.5

MEAN SPECTRAL WAVE HEIGHT (m)	1
MEAN PEAK WAVE PERIOD (sec)	7.6
MOST FREQUENT 22.5 DEGREE (CENTER) DIRECTION BAND (deg)	45
STANDARD DEVIATION OF WAVE Hmo (m)	0.6
STANDARD DEVIATION OF WAVE TP (sec)	3.6
LARGEST WAVE Hmo (m)	7.3
WAVE TP ASSOCIATED WITH LARGEST WAVE Hmo (sec)	11
PEAK DIRECTION ASSOCIATED WITH LARGEST WAVE HS (deg)	50
DATE LARGEST Hmo OCCURRED	12:00 pm September 3, 1979

Table A-3

Percent Occurance (x1000) of Wave Height and Period for All Directions (WIS Station A2010)

WAVE HEIGHT (M)	PEAK PERIOD (IN SECONDS)										
	<4.0	4.0 - 4.9	5.0 - 54.9	6.0 - 6.9	7.0 - 7.9	8.0 - 8.9	9.0 - 9.9	10.0 - 10.9	11.0 - 11.9	>12.0	TOTAL
.00- .99	6440	12005	6493	4827	4553	4409	3723	3406	3292	11486	60634
1.00-1.99	.	1632	8018	9079	2883	1887	1803	1131	918	4664	32015
2.00-2.99	.	.	30	450	2648	1579	297	224	165	556	5949
3.00-3.99	.	.	1	.	58	402	506	46	15	59	1087
4.00-4.99	.	.	3	.	.	20	121	77	11	1	233
5.00-5.99	.	.	.	.	.	.	8	10	23	5	46
6.00-6.99	.	.	.	.	.	.	.	8	.	3	11
7.00-7.99	.	.	.	.	.	.	.	.	1	.	1
8.00-8.99	.	.	.	.	.	.	.	.	.	.	0
9.00-9.99	.	.	.	.	.	.	.	.	.	.	0
10.00+	.	.	.	.	.	.	.	.	.	.	0
TOTAL	6440	13637	14545	14356	10142	8297	6458	4902	4425	16774	

MEAN Hmo(M) = 1.0 LARGEST Hmo(M) = 7.3 MEAN TP(SEC) = 7.6

associated with the largest wave, which is 11.0 sec (Table A-2). Using the above values and equations, the predicted depth of closure is 29.3 feet.

A-14. The depth of closure was also calculated using the Birkemeier equation (Birkemeier, 1985). This approach typically provides a more reasonable estimate, compared to Hallermeier's approach, which usually over-predicts the depth of closure. The Birkemeier equation is as follows:

$$d_c = 1.75\ H_e - 57.9\ (H_e^2 / gT_e^2)$$

A-15. This approach yields a depth of closure of 22.5 feet, which is a more reasonable estimate than Hallermeier's, but it is still deeper than the inner reef. This is an indication that sand could be lost offshore, but these depths of closure are not recommended for use in the design of Segment II beaches.

A-16. Analysis of the 1983 Pompano Beach/Lauderdale-by-the-Sea fill project performance, historic beach profiles for Ft. Lauderdale, and the nearshore hardbottom locations suggest that there is not a single DOC. The DOC was individually determined for each profile line by comparing beach profiles and determining at what depth the profiles converge. For Pompano Beach/Lauderdale-by-the-Sea, the pre-construction 1983 beach profiles were compared against the 1983 post-construction, 1993, and 1998 beach profiles (Sub-Appendix A-1). For example, Figure A-2a shows that for R-38 the DOC is 13.5 feet NGVD. The DOCs for Ft. Lauderdale were determined by comparing the 1980, 1993, and 1998 measured beach profiles. Since there has never been a nourishment project in Ft. Lauderdale, the DOCs are entirely based upon historic movement of the individual profile lines. An example profile (R-59) is shown in Figure A-2b, which shows a DOC of 13.0 feet NGVD.

A-17. The DOCs used for engineering analysis are shown in Table A-4. The overall average DOC for Reaches 2 and 3 is 13.4 feet NGVD. The average DOC for Ft. Lauderdale's Reach 3 is 14.4 feet NGVD, which is 1.8 feet deeper than the DOC for Reach 2. This is due to the influence of the inter-reef flats. In general, the beach profiles truncate on a reef flat for Pompano Beach/Lauderdale-by-the-Sea. The beach profiles for Ft. Lauderdale truncate near the reef, where there is, generally, higher relief.

SEA LEVEL RISE

A-18. The geological record of historic sea level variations indicates that both increases and decreases in global sea level have occurred. Some authorities claim that evidence indicates our planet may be entering a new ice age, which would result in a lower sea level. Others argue that increasing atmospheric concentrations of carbon dioxide and other gases are causing the earth to warm, contributing to a sea level rise. Such changes to absolute global sea level change are known as eustatic sea level change. The sea level rise rate for this study is 0.0075 ft/yr, based on data at Miami Beach (Lyles et al., 1988). For a 50-year project life, the sea level is predicted to rise 0.38 feet, but it is predicted to rise only 0.14 feet for the remaining 19 years of the project.

Example Depth of Closure for Pompano Beach/Lauderdale-by-the-Sea (R38)

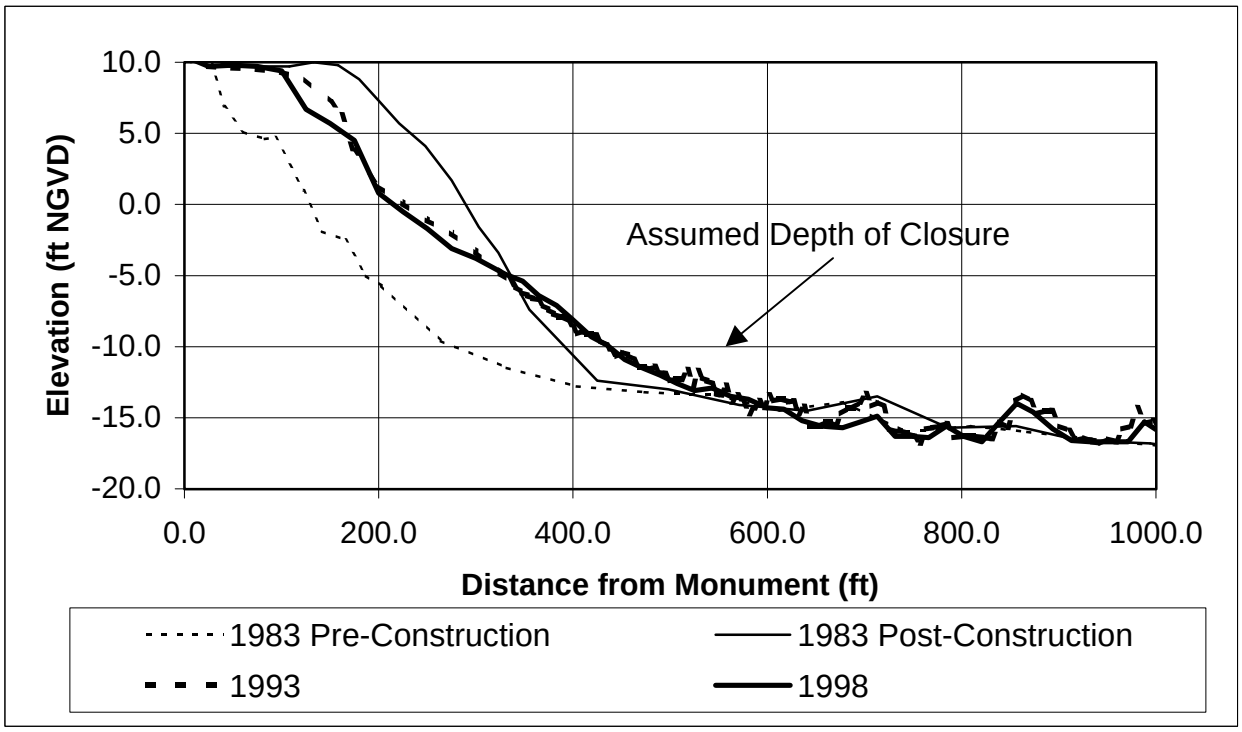


Figure A-2a

Example Depth of Closure for Ft. Lauderdale (R59)

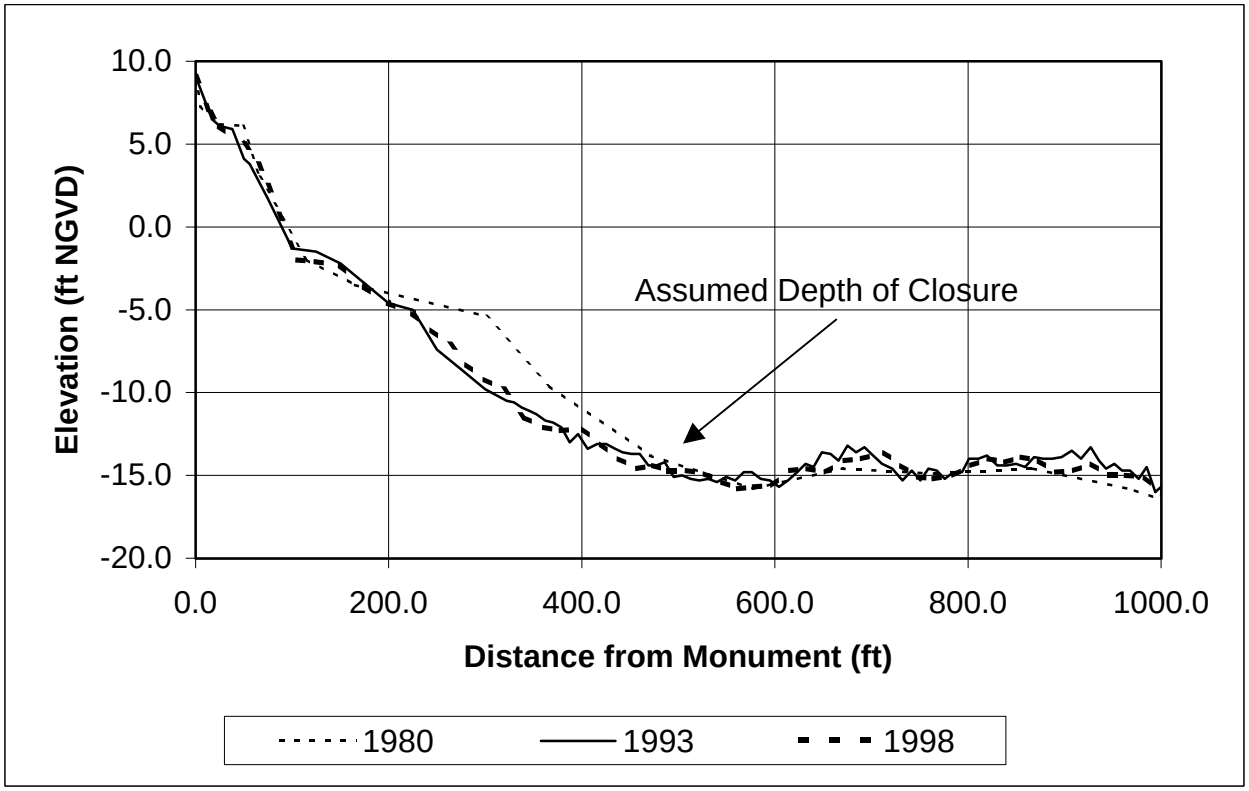


Figure A-2b

TABLE A-4

Estimated Depth of Closure

Reach 2 Pompano Beach/LBTS		Reach 3 (Ft. Lauderdale)	
Monument	DOC[1] (-ft NGVD)	Monument	DOC[1] (-ft NGVD)
R36	12.0	R54	13.5
R37	15.0	R55	15.5
R38	13.5	R56	15.0
R39	12.5	R57	15.5
R40	14.0	R58	15.5
R41	13.0	R59	13.0
R42	10.0	R60	14.0
R43	10.5	R61	12.0
R44	9.5	R62	15.0
R45	12.0	R63	14.5
R46	12.5	R64	15.5
R47	13.0	R65	14.5
R48	11.0	R66	14.5
R49	11.0	R67	14.0
R50	11.0	R68	14.0
R51	13.0	R69	15.0
R52	16.5	R70	16.5
R53	14.0	R71	16.0
		R72	12.0
Average	12.4	R73	13.0
		R74	10.0
		Average	14.2
Overall Average		13.4	

[1] Depth of Closure (DOC) determined by historic profile convergence

A-19. In 1995, the U.S. Environmental Protection Agency (EPA) published a report entitled *The Probability of Sea Level Rise* (Titus and Narayanan, 1995). This report provides sea level information in a form that can be incorporated into engineering designs, decision analyses, and legal opinions. The report presents a methodology for estimating sea level rise at a particular location by simply adding the current rate of sea level rise (based on historical data) to a normalized projection. The normalized projections estimate the extent to which future sea level rise will exceed what would have happened if current trends simply continued. They are based on initial conditions which correspond to the year 1990. For this study Miami Beach, Florida was chosen as the best data site, as it is the location closest to Broward County for which historic water level information was available. The historic rate of sea level rise at Miami Beach was estimated as 0.0075 ft/yr (Lyles et al., 1988).

SHORELINE EROSION AND RECESSION DUE TO SEA LEVEL RISE

A-20. Experience indicates that as relative sea level rises, the shoreline will be subjected to increased flooding and profile recession. Bruun (1962) proposed a formula for estimating the rate of shoreline recession based on the local rate of sea level rise. This methodology also includes consideration of local topography and bathymetry. Bruun's approach assumes that with a rise in sea level, the beach profile will attempt to re-establish the same bottom depths relative to the surface of the sea that existed before the sea level rise. As a result, the beach profile shape relative to the mean water level will re-establish itself. If the longshore littoral transport in and out of a given shoreline area is equal, then the quantity of material required to reestablish the nearshore slope must be derived from erosion of the shore. Shoreline recession resulting from sea level rise can be estimated using Bruun's Rule, as defined below:

$$x = ab/(h+d)$$

where,

- x = shoreline recession (in feet) attributable to sea level rise.
- h = elevation of shoreline above NGVD (+9.0 feet berm).
- d = depth contour beyond which there is no significant sediment motion (13.4 feet, yearly depth limit).
- b = horizontal distance of the active beach profile (average 500 feet) berm elevation to the depth contour d.
- a = specified relative sea level rise for time period t.

A-21. This procedure is only used for estimating long term changes and not as a substitute for the analysis of historical shoreline and profile changes. Throughout the 50-year project the predicted shoreline recession is 8.4 feet (0.17 ft/yr). The shoreline is predicted to recede only 3.2 feet for the remaining 19 years. The recession rate of 0.17 ft/yr due to sea level rise is not significant when compared to historical shoreline change. Under the present sea level rise rate, it is not necessary to include sea level rise as a design parameter for the Federal project. The effect of sea level rise on the Federal project should be reconsidered if the rate of measured sea level rise increases significantly.

COASTAL PROCESSES

A-22. Segment II has been divided into four reaches based upon common shoreline and volumetric characteristics and political boundaries. The reaches are defined in Table A-5 (Figure A-1). All shoreline changes are based on the movement of the mean high water (MHW) with an elevation of +1.9 feet NGVD. The volumetric changes were calculated to –16 feet NGVD. This depth, instead of the DOC, was used so that the volumetric analysis could be compared to past studies, where a DOC of –16 feet NGVD was assumed. Shoreline and volumetric changes are summarized in Table A-6 and Figures A-3a and A-3b.

TABLE A-5
REACHES DEFINED FOR SEGMENT II

Reach	Area	From	To	Length (mi)
1	Northern Pompano Beach	R25	R36	2.0
2	Southern Pompano Beach & Lauderdale-by-the-Sea	R36	R54	3.4
3	North Ft. Lauderdale	R54	R74	4.0
4	South Ft. Lauderdale	R75	R85	1.9
Total		R25	R85	11.3

TABLE A-6
VOLUME AND SHORELINE CHANGE RATES

Reach	Monuments	Reach Length (ft)	Total Volume Change (cy)[(1)(2)]	Average Shoreline Change (ft/yr)[(1)(2)]
Reach 1	R25-35	10,500	383,300	1.0
Reach 2a	R36-43	7,700	-191,500	-4.6
Reach 2b	R44-53	10,100	250,500	-4.4
Reach 3	R54-74	21,100	-71,000	-0.2
Reach 4	R75-84	10,000	114,000	1.8
Reaches 2 & 3	R36-74	38,900	-12,100	-3.0
Total	R25-84	59,300	485,300	-1.3

Notes:
(1) Reaches 1 and 2 data are from August 1983 to September 1998
(2) Reaches 3 and 4 data are from October 1993 to September 1998

Pompano Beach/Lauderdale-by-the-Sea Shoreline and Volumetric Change Rates (August 1983 to September 1998)

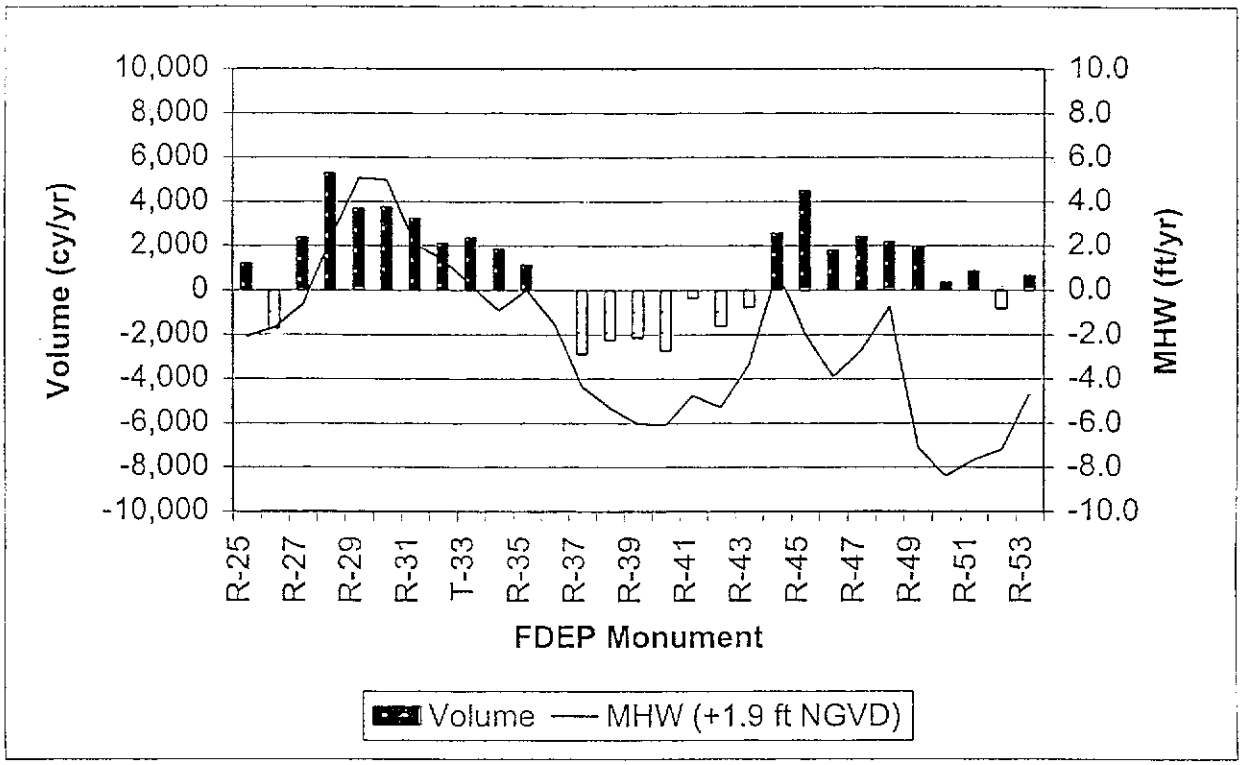


Figure A-3a

Ft. Lauderdale Shoreline and Volumetric Change Rates (October 1993 to September 1998)

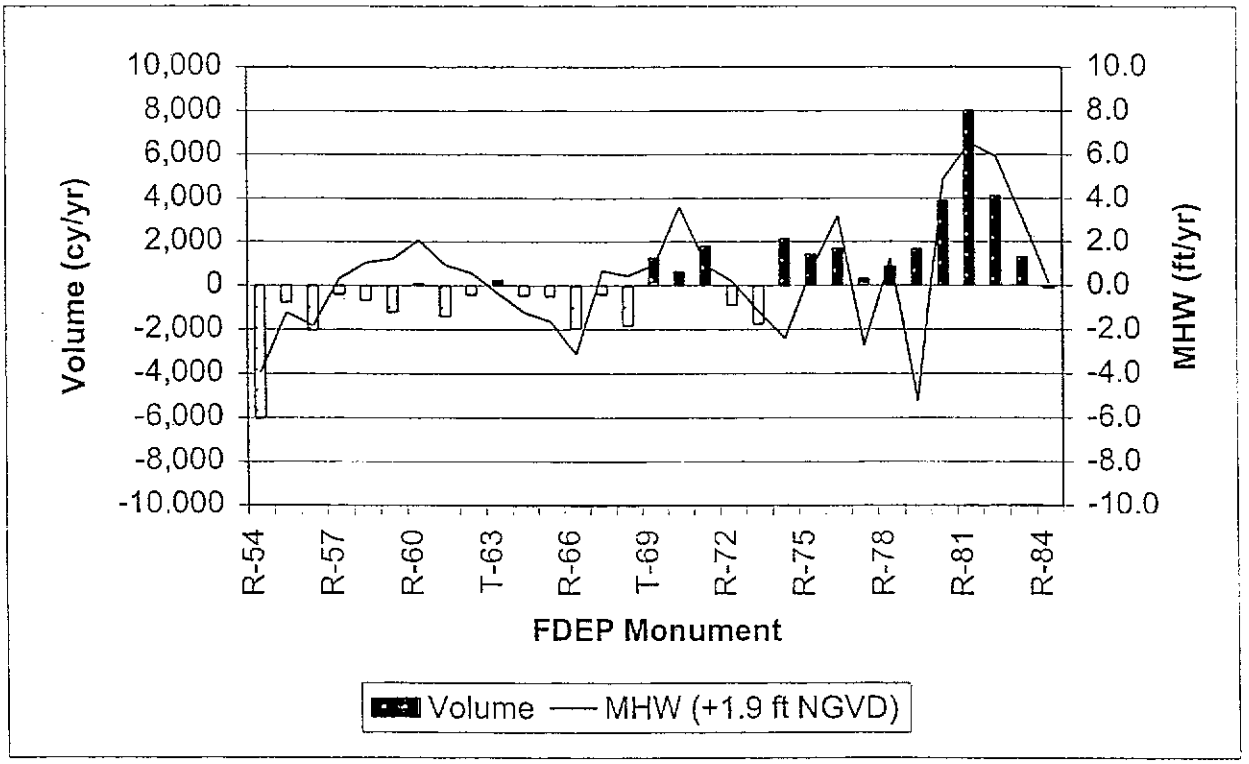


Figure A-3b

HISTORICAL SHORELINE CHANGE

Pompano Beach/Lauderdale-by-the-Sea

A-23. 1929 to 1961. The average annual recession rate for Pompano Beach and Lauderdale-by-the-Sea ranged from –4 to -8 ft/yr (USACE, 1994). There were regions of erosion and accretion, with the highest erosion downdrift of Hillsboro Inlet. The erosion at the inlet was due to inlet effects and sparse sand bypassing for this time period.

A-24. 1970 to 1978. Initial construction of the Federal project was completed in 1970 between R-31 and R-49. The average shoreline change of the constructed beach between R-32 and R-49 was –22 ft, resulting in an average shoreline recession rate of 2.8 ft/yr (USACE, 1981). The project area was erosional, except for an accretional section from R41 to R46. In the erosive sections (R32-R40 and R47-48), the average erosion rate was 6.3 ft/yr. Much of this erosion can be attributed to initial cross shore adjustment of the beach fill.

A-25. 1983 to 1988. Following the 1983 nourishment project, the shoreline (from FDEP monuments R25 to R53) experienced recession of 56 ft at a rate of 11.2 ft/yr. The shoreline was accretional only from R29 to R32 at a rate of 3.6 ft/yr (USACE, 1994). The recession is mainly a result of the initial adjustment of the nourishment.

A-26. 1983 to 1998. In Reach 1 (Figure A-1), the shoreline has accreted a total of 14.7 ft from 1983 to 1998, or an annual average of 1.0 ft/yr (Table A-6). Overall, this reach is accretional or stable, because of the increased transfer of sand across Hillsboro Inlet since the mid-1980's. The only erosional profile lines in this reach are from R25 to R27, adjacent to Hillsboro Inlet, probably due to the shadow effect of the inlet (Figure A-3a).

A-27. 1983 to 1988. Reach 2 (Figure A-1) has lost an average of 67 feet (4.5 ft/yr) of shoreline. There are areas within this reach (R49-52) which have erosion rates of more than 7.0 ft/yr (Figure A-3a). Some of the shoreline recession is the expected profile adjustment of the 1983 nourishment. The hotspot from R37 to R43 is a result of the shoreline headland feature in this area. Also, there is a gap in the reef system in the proximity of R48 (OAI/CPE, 1998). This potential offshore sink for sediment, may have contributed to the shoreline recession from R45 to R53.

Ft. Lauderdale

A-28. 1947 to 1978. From FDEP monuments R54 to R69, the shoreline retreated an average of 44.4 ft (1.4 ft/yr). No areas in this section of Ft. Lauderdale were accretional (USACE, 1981).

A-29. 1979 to 1993. Between 1979 and 1993, the average net shoreline change for Reach 3 (Figure A-1) has been 0.2 ft/yr (USACE, 1996). This reach has alternating regions of erosion and accretion. There are accretional sections from R54-R59, where the beach has accreted as much as 3 ft/yr, and R64 to R69, where there was mild accretion. R60 to R63 shows mild erosion and R70 to R74 was eroding at more than 1.5 ft/yr.

A-30. 1979 to 1993. Reach 4 is erosional where it borders with Reach 3, though the reach is accretional near Port Everglades due to the trapping of the southerly longshore sediment transport updrift of the inlet. The southern Ft. Lauderdale shoreline advanced an average total of 44.5 feet. The area closest to Port Everglades advanced an average total of 97.3 feet, while the region between R-75 to R-79 receded a moderate total of -8.3 feet.

A-31. 1993 to 1998. From 1993 to 1998, the shoreline for Reach 3 (Figure A-1) has lost an average of 0.9 ft. (-0.2 ft/yr). Areas of erosion and accretion alternate alongshore, with a maximum advance of 17.7 feet at R-70 and a maximum recession of -19.5 feet and -15.3 feet at R-54 and R-66, respectively (Figure A-3b). Overall, this reach is moderately erosive.

A-32. 1993 to 1998. Reach 4 (Figure A-1) is accretional, advancing an average total of 8.7 feet (Figure A-3b). Profile lines R77 and R79 have eroded a total of 13.4 ft and 25.7 ft, respectively, and are the only receding profiles. Overall, this reach has been accretional for the past 50 years, due to the impoundment of sand updrift of Port Everglades entrance.

HISTORIC VOLUME CHANGE

Pompano Beach/Lauderdale-by-the-Sea

A-33. 1929 to 1978. Pompano Beach and Lauderdale-by-the-Sea lost an average 33,300 cy/yr of sand to the -18 ft. NGVD contour (USACE, 1963). The 1970 project lost a total 292,000 cy of sand (to the –12 ft NGVD contour) in the 8 years after construction (USACE, 1994), which is 27% of the total volume placed.

A-34. 1983 to 1988. The 1983 Nourishment Project lost a total of -82,700 cy of sand (16,500 cy/yr) to the -12 ft NGVD contour (USACE, 1994) by 1988. Nevertheless, the project losses to the –6 ft NGVD contour were 350,800 cy. This indicates that between the –6 ft NGVD and the –12 ft NGVD contour, 268,100 cy of material were gained. Though sand is expected to move from the dry beach to offshore as the beach fill equilibrates, profile comparisons suggest that the profiles also flattened.

A-35. 1983 to 1998. From 1983 to 1998, Reach 1 gained 383,300 cy (25,600 cy/yr) of material (Table A-6) because the rate of mechanical inlet bypassing increased in the mid-1980's from the order of 60,000 cy/yr to 130,000 cy/yr (Table A-7).

A-36. 1983 to 1998. Reach 2 has gained 58,900 cy of material. Dividing the reach into two sections (Reach 2a and 2b) shows that from R36 to R43 the beach lost 191,500 cy (12,800 cy/yr) and from R44 to R53 the beach gained 250,500 cy (16,700 cy/yr) of sand (Table A-6). The loss in Reach 2a is consistent with shoreline retreat in this region, but the volume gain in Reach 2b is not consistent with the shoreline recession, which will be addressed in the next section.

Ft. Lauderdale

A-37. 1929 to 1978. Ft. Lauderdale beaches (From FDEP monument R54 to R84) have lost a total of 592,200 cy of material, or an average of 12,100 cy/yr (USACE, 1981). The area updrift of Port Everglades began to stabilize after 1961, when a submerged spoil bar was created north

of the channel as a result of material dredged from the adjacent Port Everglades entrance channel.

A-38. 1979 to 1993. From 1979 to 1993, Reach 3 gained a total of 52,000 cy of sand, but there is an erosional area from R64-R66, which lost 289,200 cy of sand (USACE, 1996). Some of the accretion may be attributed to spreading losses of the 1983 Pompano Beach/Lauderdale-by-the-Sea Project.

A-39. 1979 to 1993. Reach 4 has gained a total of 83,100 cy of sand from 1979 to 1993. Though this reach is overall accretional due to updrift effects of Port Everglades, there was a highly erosive area form R75 to R78 (USACE, 1995) which lost 154,800 cy of material. The shoreline recession and volume loss from R75-R78 may be related to a discontinuity in the reef line (OAI/CPE, 1998).

A-40. 1993 to 1998. From 1993 to 1998, Reach 3 lost a total of 71,000 cy of sand (Table A-6). Only a few profile lines showed accretion, most significantly at R69 to R71 and R74 to R75 (Figure A-3b).

A-41. 1993 to 1998. Reach 4 continued to accrete 114,000 cy of sand due to the updrift effects of Port Everglades (Table A-6). Only one profile, R-84, showed a small amount of erosion (Figure A-3b).

VOLUME CHANGE AND SHORELINE CHANGE CORRELATION

A-42. For some areas in Segment II, changes in shoreline and sand volume do not correlate (USACE, 1995; OAI/CPE, 1998). Reach 2b shows volumetric accretion, but with significant shoreline recession (Figure A-3a). The lack of correlation may be caused by physical processes. The fill sand placed in 1970, or 1983 may have been finer than the native beach sands. Generally, finer sands create a flatter beach profile, causing increased sand deposition offshore. The Structural Stabilization Study (OAI/CPE, 1998) observed that some profiles were not in equilibrium prior to the 1983 renourishment, with a steep, highly eroded profile. The 1983 nourishment provided enough sand to bring the submerged portion of the active beach back towards equilibrium, but with a disproportionate loss from the upper profile. In either case, the beach needs to be renourished in spite of the volumetric accretion in the region.

INLET IMPACTS

A-43. Hillsboro Inlet and Port Everglades' entrance have positive impacts on the Pompano Beach-Ft. Lauderdale segment. Typically, beaches downdrift of an inlet are erosional, unless the sand that accumulates on the updrift beach and in the inlet can be transferred to the downdrift beach. Material is mechanically bypassed around Hillsboro Inlet to Pompano Beach, and the rate has increased since the mid-1980's (Table A-7). The bypassing rate for 1989-1998 (134,300 cy/yr) is more than double the 1979-1988 (64,800 cy/yr) rate. This rate is maintaining northern Pompano Beach (Reach 1) which it was erosional in prior decades. The 1983-1998 volumetric change for Reaches 1, 2a, and 2b was 442,200 cy of accretion. During this timeframe bypassing

was 1,849,400 cy. It is recognized that a small amount of sand (about 10,000 cy/yr) returns to the inlet (CPE, 1992) as a result of northerly transport. The wave-induced loss of sand on Reaches 1, 2a, and 2b between 1983 and 1998 is equal to the measured gain (442,200 cy) minus the net bypassing (1,699,400) or –1,257,200 cy.

TABLE A-7
HILLSBORO INLET DREDGE AND BYPASSING VOLUMES
(cy)

YEAR	QUANTITY	YEAR	QUANTITY
1979	22,000	1989	136,500
1980	25,000	1990	167,900
1981	25,000	1991	93,600
1982	70,000	1992	160,100
1983	51,100	1993	161,700
1984	60,300	1994	162,400
1985	108,800	1995	138,500
1986	134,000	1996	139,100
1987	62,200	1997	100,500
1988	90,200	1998	82,400
SUB-TOTAL (1979-1988): 648,400 AVERAGE ANNUAL RATE: 64,800		SUB-TOTAL (1989-1998): 1,342,772 AVERAGE ANNUAL RATE: 134,300	
TOTAL: (1979-1998) 1,991,172 AVERAGE ANNUAL RATE: 99,559			

A-44. Port Everglades' entrance, with its long jetties, acts as a barrier and trap to sediment movement in southern Ft. Lauderdale (Reach 4). The realignment of the north jetty in 1980 increased the trapping capacity. The submerged spoil mound north of the inlet acts like a submerged jetty, further increasing the trapping capacity. The trapped sand has created a stable or accreting beach for almost two miles north of the inlet.

EXISTING SHORELINE STRUCTURES

A-45. The majority of the upland development of Pompano Beach, Lauderdale-by-the-Sea, and Ft. Lauderdale are protected by structures. Approximately 69% of the properties contain structures (USACE, 1996). The primary structures are low seawalls protecting private development with a setback from the water's edge (Table A-8). However, nearly a mile of Segment II is protected by seawalls over 10 feet in height. The improvements made to Highway A1A in Ft. Lauderdale in the late 1990's added a small seawall along the landward edge of the beach, increasing the small seawall length by 8,150 feet. Since the seawall is built only on a

spread footer, it provides little protection against beach erosion and storm recession. Two derelict groins were identified near R-40 in Pompano Beach during a February 2000 field inspection. One groin (remnants of the New River Inlet jetties) is located near R-79 in southern Ft. Lauderdale. Two fishing piers exist within the project area.

TABLE A-8

STRUCTURAL ARMORING INVENTORY FOR SEGMENT II

ITEM	NUMBER OF STRUCTURES	LENGTH (feet)	PERCENT
Wall: Small	124	32,280	40.5%
Wall: Med	48	11,600	19.5%
Wall: Large	14	4,900	8.2%
Rubble: Small	5	690	1.2%
Total	191	41,320	69.4%

Note: Data Based on USACE (1995).

BEACH SLOPES

A-46. The Segment II beaches do not have a uniform sand grain size (SEAI, 1999) and a portion of the segment was renourished in 1983. Furthermore, sand is continually bypassed from Hillsboro Inlet, so due to the variety of beach materials, the equilibrium beach slopes are not uniform in Segment II. The traditional design methods used for the authorized project use a single template of the entire project area. A more accurate prediction of profile performance is achieved when actual profile slopes are considered by reach. The slopes are based upon the 1998 survey, were calculated for Reaches 2a, 2b and 3, and are shown in Table A-9. Equilibrium beach slopes should be similar to the 1998 slopes.

TABLE A-9

AVERAGE BEACH CHARACTERISTICS

Location	Monuments	Beach Slopes (1V:xH)		Authorized Slopes (1V:xH)	
		Berm to -2.5 ft NGVD	-2.5 ft to -13.5 ft NGVD	Onshore	Offshore
Reach 2a	R36-43	13	28	15	30
Reach 2b	R44-53	14	35	15	30
Reach 3	R54-74	11	29	15	30

Note: 1) Beach slopes are based on 1998 data.

BORROW AREA COMPATIBILITY

A-47. A sediment compatibility analysis was conducted for each borrow area and the existing beach material. The composite grain size distributions were used to represent the potential offshore borrow areas (Appendix E). Appendix E identifies seven borrow areas that can be utilized for this project, though only Borrow Areas I and II will be considered for use in Segment II because of proximity of the borrow areas to the beach segments and compatibility.

A-48. Sand is considered compatible with the existing beach if it has the same mean grain size or is coarser. However, if the beach fill material is finer than the existing material, an additional amount of fill material is necessary. The beach slope is a function of sand size; a beach with fine sand is more mildly sloped than a beach which has coarser sand. When fill material is finer than the existing sand, extra fill is necessary to account for the more mild beach slopes.

A-49. For this study, a modified equilibrium method was used (Munez-Perez, et al., 1999). The equilibrium method employs a shape factor, which is a function of mean grain size (Dean, 1991), but, the equilibrium method does not take into account hardbottom or offshore reef features. The modified equilibrium method uses a shape factor that is a function of grain size, depth of hardbottom, and the cross-shore width of the hardbottom. The estimated overfill volumes (cy/ft of beach) are shown in Table A-10. Borrow Areas I and II are compatible with Segment II beaches.

TABLE A-10

ESTIMATED OVERFILL DENSITY
(cy/ft)

Borrow Area		Reach 2a (R36-43)	Reach 2b (R44-53)	Reach 3 (R54-74)
Number	Grain Size (mm)	0.27	0.29	0.33
I	0.39	0.0	0.0	0.0
II	0.31	0.0	0.0	0.0

STORM SURGE

A-50. Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. The increased elevation is attributable to a variety of factors, which include waves, wind shear stress, and atmospheric pressure. An estimate of these water level changes is essential to the design of the berm elevation of a beach fill area. Higher water elevations will increase the potential for recession, long-term erosion, and overwash due to severe waves.

A-51. The major threats to the shoreline of Broward County are surge and waves caused by extra-tropical and tropical storms. Since 1960, major storms that have affected Broward County include Hurricane Donna (1960), Hurricane Cleo (1964), Hurricane Isbell (1964), Hurricane Betsy (1965), Hurricane David (1979), Hurricane Andrew (1992), Tropical Storm Gordon (1994), Tropical Storm Josephine (1996), Tropical Storm Mitch (1998), and Hurricane Irene (1999). Four notable northeaster storms that have influenced the Broward County shoreline occurred in March 1962, November 1984, October 1991 and October 1992. It is possible to classify and predict storm surge elevations for various storms through the use of historical information and theoretical models.

A-52. The Federal Emergency Management Agency (FEMA) has performed investigations to determine 10 to 100 year return period storm surge elevations for Broward County (USACE, 1995). The methodology used in this study was developed by the National Academy of Sciences. Assumptions made in the analysis include: 1) breaking wave heights are limited to 0.78 of the local still water depth, 2) the wave crest constitutes 70% of the wave height, and 3) waves are dissipated by features such as sand dunes, dikes and seawalls, buildings, and vegetation. Regeneration of wave heights over areas of large fetch was also considered. Figure A-4 includes the resulting surge elevations and frequency of occurrence for the Broward County coast. For the 100-year return interval, the maximum predicted crest elevation is 7.5 feet.

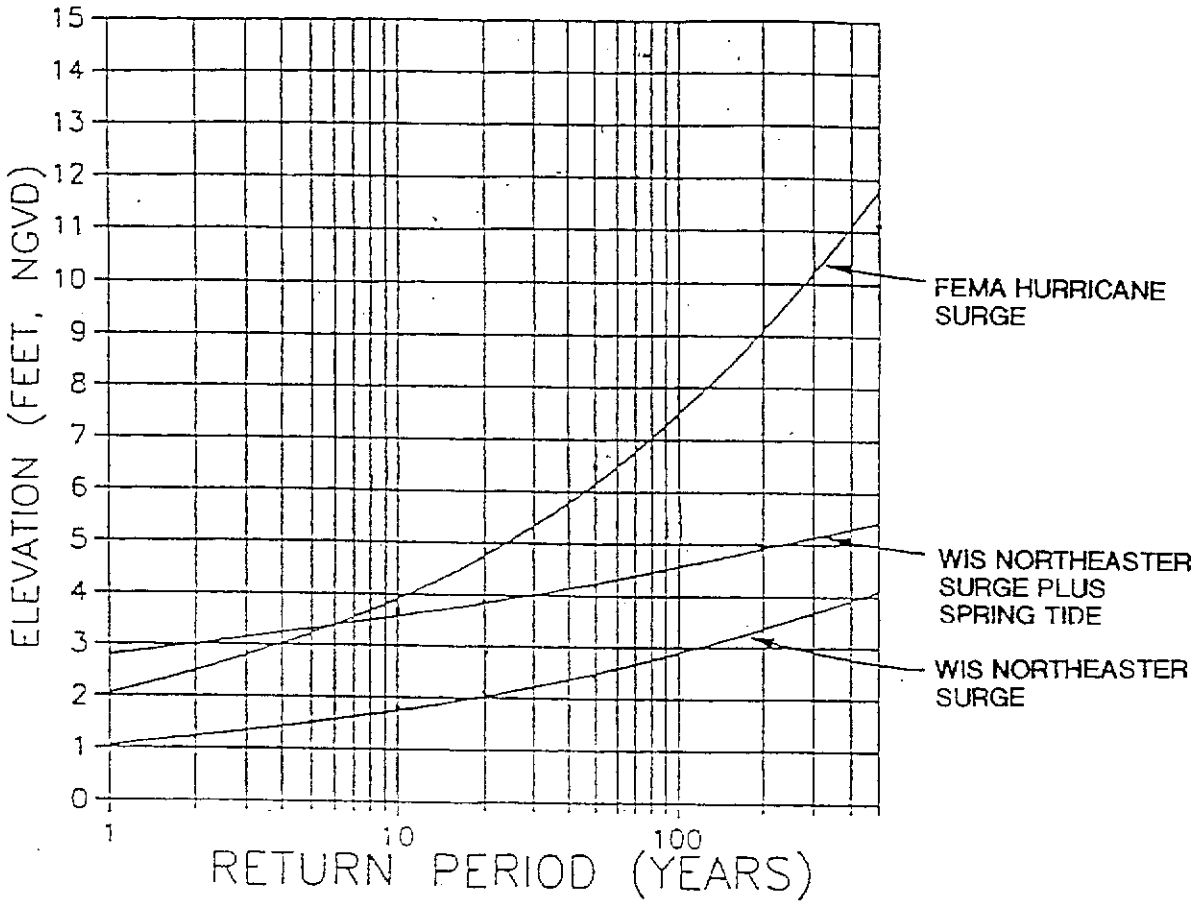
A-53. Higher frequency of occurrence storms and storm surge elevation for other meteorological induced water-level anomalies (i.e., northeaster storm types) were obtained from WIS Report 7 (USACE, 1995). Hindcasting of storm surges was performed utilizing historical wind and pressure fields.

A-54. The FEMA hurricane surge curve is based on data points for the 10, 50, 100, and 500 year recurrence interval events. The WIS northeaster surge curve for Broward County is based on data points for the 2, 5, 10, 20 and 50 year recurrence intervals at Miami Beach, Florida. The WIS northeaster surge data does not include tide, therefore, since the normal duration of a northeaster is several days (i.e., several tidal cycles), a curve which provides the WIS northeaster surge height with a spring tide, a worst case scenario, is included on Figure A-4. The FEMA hurricane surge curve is extrapolated below the 10 year recurrence interval event and the WIS northeaster surge curve is extrapolated above the 50 year recurrence interval event. For this reason, considerable care should be used when selecting data points from the extrapolated portion of the curves.

CROSS-SHORE SEDIMENT TRANSPORT

A-55. Cross-shore sediment transport characteristics for the project area beaches were estimated using the Storm Induced BEAch CHange model, SBEACH (Larson and Kraus, 1989), which simulates beach profile changes resulting from varying storm waves and water levels. SBEACH has significant capabilities that make it useful for quantitative studies of beach profile response to storms. SBEACH version 3.0 is additionally capable of calculating the effect of nearshore hardbottom on profile evolution.

A-56. A formal calibration and verification of the model within the project area could not be conducted due to the lack of historical profile data. As an alternative, a sensitivity analysis was conducted based on SBEACH coefficients used in previous studies within the South Florida Region. SBEACH was run on three profiles representative of the project area with storm input data from three separate storms. Sequential runs were conducted using each of the reported sets of calibration coefficients, and the resulting profile recession for each reach was tabulated (Table A-11). Based on these results the coefficient values used in Martin County (USACE, 1994) were adopted for this study, since these coefficients give results that are closest to the mean recession rates for all cases. The calibration procedure established the following values as the selected calibration parameters, a) transport rate coefficient (K) of 0.0000015 m^4/N, b) slope dependent coefficient (ε) of 0.0015 m^2/s, and c) transport rate decay factor (LAMM) of 0.40 m^{-1}.



SOURCE: COAST OF FLORIDA STUDY - REGION III (USACE, 1996)

FIGURE A-4

BROWARD COUNTY STORM SURGE FREQUENCY CURVE
COAST OF FLORIDA STUDY - REGION III

TABLE A-11

SENSITIVITY ANALYSIS FOR SBEACH CALIBRATION

		Distance from Pre-Storm MHW to Landward Limit of 0.5 foot erosion (feet)						
Reach	Storm	COFS	Default	Ponce	Brevard	Martin	AVG (ft)	SD (ft)
R86-R99	E24	0	0	0	0	0	0	0
	H16	166.0	162.9	174.7	167.7	152.3	164.7	8.2
	H31	157.4	159.9	166.0	163.2	163.8	164.1	4.5
R100-R104	E24	41.0	43.3	41.0	41.5	41.4	41.6	1.0
	H16	169.6	188.3	186.0	186.9	185.9	183.3	7.8
	H31	201.5	224.9	214.6	206.4	214.2	212.3	8.9
R105-R128	E24	0.0	41.7	39.1	38.8	38.5	31.6	17.7
	H16	137.0	144.0	159.9	159.1	133.8	146.8	12.2
	H31	132.7	142.2	136.0	130.0	138.4	135.9	4.8

Adjusted Calibration Parameters					
Project	COFS	Default	Ponce	Brevard	Martin
K (m^4/N)	1.35E-06	1.75E-06	1.75E-06	1.70E-06	1.50E-06
EPS (m^2/s)	0.001	0.002	0.001	0.001	0.0015
LAMM (m^{-1})	0.5	0.4	0.5	0.5	0.4

A-57. The cross-shore sediment transport analysis procedure involved the use of the SBEACH model to perform multiple simulations of beach recession due to historical tropical and extratropical storms. Since Reaches 1 and 4 are not being considered for nourishment, only two reaches were examined. Pompano Beach/Lauderdale-by-the-Sea extends from FDEP monument R36 to R53 (Reach 2). The Ft. Lauderdale segment extends from R54 to R74 (Reach 3). For each reach, one representative FDEP profile was adopted for use within the SBEACH simulations. For the Pompano Beach/Lauderdale-by-the-Sea section, R38 was adopted as the characteristic profile, and R64 was chosen for Ft. Lauderdale (Sub-Appendix A-1).

A-58. Joint-Probability Analysis of Storm-induced Beach Recession. Proposed shore protection measures must be subjected to a benefit-cost analysis in order to assess whether Federal participation in the project is appropriate. Primary benefits are typically quantified in terms of the reduction of storm-induced damages to existing property and/or structures. In order to quantify those benefits, one must estimate a) the damage potential which exists without the proposed protection measures (i.e., for existing conditions), and b) the damage potential which exists with shore protection measures in place. Benefits are expressed as the reduction in storm-

induced damages resulting from the presence of the shore protection measures. In order to account for risks and uncertainties inherent to the analysis procedure, methods were required in the form of recession versus frequency of occurrence relationships. The Empirical Simulation Technique (EST) (Borgman et al., 1992) was selected as the joint-probability analysis tool used to establish those relationships. The beach recession analysis procedure can be described by applying the following major tasks:

1. Identify storm events that have impacted the study area.
2. Construct or obtain the water surface elevation and wave field hydrographs characteristic of each of the identified storms while in the vicinity of the study site.
3. Apply the numerical model, SBEACH, to estimate the beach recession associated with each of the storm events.
4. Construct EST input data files using descriptive storm parameters and calculated recession values.
5. Use the EST to generate multiple repetitions of multi-year scenarios of storm events and their corresponding beach erosion confidence limits.
6. Apply the resulting recession-frequency curves as input to an appropriate economics based model for computation of damages, costs, and benefits.

A-59. The initial step in any storm-induced recession/frequency analysis is identification of all historical storms that have impacted the area of interest. For Atlantic coast sites, such as Broward County, the shoreline is subjected to both tropical cyclones (tropical depressions, tropical storms, and hurricanes) and extratropical storms (northeasters). While tropical storms are often characterized by very high wind, wave, and surge conditions, the longer duration of extratropical storms can result in beach erosion of equal or greater magnitude than the erosion caused by storms of tropical origin. Once the historical storms of interest are identified, corresponding storm surge hydrographs and wave condition time series must be extracted from appropriate data sources. For this application, those data sources consisted of the DRP storm surge database and the WIS hindcast wave database.

A-60. Tropical Cyclone Selection. The tropical surge database developed by Coastal Hydraulics Laboratory (formerly CERC), which contains a record of 104 years of tropical storm activity, indicates that 12 tropical cyclones have significantly influenced the project area. This corresponds to a recurrence frequency of roughly one tropical cyclone every nine years. For this application, a significant influence implies the storm resulted in a surge of at least 1.64 feet at the site in question. The 12 storms identified for the project area are listed in Table A-12. Individual storm tracks and maximum surge elevations at all nearshore stations are available in the tropical cyclone database summary report (Scheffner et al., 1994). Wave conditions characteristic of tropical cyclones were computed in accordance with procedures specified in the Shore Protection Manual (USACE, 1984). Storm position and intensity values were specified based on information from the National Hurricane Center Tropical Storm Database. Tidal influence was accounted for by assuming that each storm event has an equal probability of occurring at any time during the tidal cycle. For this analysis, that assumption was simplified by allowing the onset of the storm conditions to coincide with four individual tidal phases. Tidal constituents of the project site were obtained from the Dredging Response Project (DRP) database for computation of tide elevations. The result of combining storm surge and tidal

components of the total surge elevation is a four-fold increase in the number of individual storms used in the SBEACH analysis.

TABLE A-12

TROPICAL STORMS WITH INFLUENCE ON BROWARD COUNTY

Storm Number	NHC Database Number (Name)	Date
1	112	8/3/1899
2	127	8/4/1901
3	189	10/6/1909
4	276	9/11/1926
5	292	9/6/1928
6	296	9/22/1929
7	331	8/31/1933
8	353	8/29/1935
9	357	10/30/1935
10	461	9/4/1947
11	473	9/18/1948
12	629	8/20/1964(Cleo)

A-61. Extratropical Storm Selection. Analysis of the nearshore water level estimates within the DRP extratropical storm database indicate storm surge levels significantly less than expected for this region. The maximum surge value, which roughly corresponds to a 16-year surge event, was determined to be only 0.48 feet. Based on this result, an alternate method was used to generate the necessary surge data for the SBEACH extratropical storm simulations. Each extratropical storm event was first identified within the WIS wave data for station A2010 for the time period from September 1977 to August 1993. Each storm was then ranked based on the maximum wave height of each storm event. This ranking was then used to assign a relative return period (frequency) to the event. The surge magnitude for each storm was then determined based on the FEMA surge curve for the region and the relative frequency of each storm. SBEACH input storm hydrographs were developed based on these surge magnitudes using the storm hydrograph algorithm in the Beach Fill Module software package. Based on this procedure, 13 extratropical storms were identified for use within the SBEACH simulations (Table A-13). This corresponds to a significant extratropical event every 1.2 years. Wave conditions corresponding to each of the extratropical storms were obtained from the WIS hindcast database, Station A2010. This deepwater wave data was subsequently transformed to nearshore conditions for the depth corresponding to the offshore depth of the profiles used in the SBEACH simulations. This transformation was accomplished using the WAVETRAN application within the Shoreline Modeling System (Gravens, 1992).

TABLE A-13

EXTRATROPICAL STORMS WITH INFLUENCE ON BROWARD COUNTY

Storm Number	Date	Rank	Return Freq. (Years)	Surge (Feet)
1	12/28/77	3	5.3	3
2	1/17/78	8	2	2.3
3	2/3/79	12	1.3	2.2
4	11/20/79	9	1.8	2.3
5	1/16/80	11	1.5	2.2
6	11/25/80	4	4	2.8
7	11/25/82	13	1.2	2.2
8	12/30/82	1	16	4.6
9	1/20/83	2	8	3.5
10	11/22/83	5	3.2	2.6
11	2/9/88	6	2.7	2.5
12	10/29/90	10	1.6	2.2
13	11/15/91	14	1.4	2.2

A-62. In summary, the selection of storm events from the available databases resulted in the identification of 12 tropical cyclones and 13 extratropical storms that have influenced Broward County beaches. The tropical storm database encompasses those storms that occurred during the 104-year period from 1886 through 1989. The extratropical storm database includes 16 years of data, from September 1977 through August 1993. Estimated frequencies of occurrence for tropical cyclones and extratropical storms that impact the project shoreline are 0.12 and 0.83 storms per year, respectively.

A-63. SBEACH Model Results. Beach recession for each of the extratropical and tropical storms for each tide phase was determined through application of SBEACH to each of the characteristic reach profiles. From these simulations, the beach recession for each storm was calculated for each reach. Throughout this discussion, recession is defined as the horizontal distance from the mean high water mark on the pre-storm profile to the most landward point where the vertical difference in pre- and post-storm profiles equals 0.5 feet.

A-64. Significant beach recession was observed for the majority of storm simulations. Pompano Beach/Lauderdale-by-the-Sea showed a greater maximum recession compared to the Ft. Lauderdale reach. The beach face is milder for Pompano Beach/Lauderdale-by-the-Sea than it is for Ft. Lauderdale (Table A-9). A beach with a mildly sloped beach face will experience greater storm recession than steeper beaches. The tropical storm runs generally produced greater recession than the extratropical storms. Recession results are summarized in Table A-14.

A-65. Overall, the SBEACH analysis produced appropriate data for the performance of the project cost-benefit analysis. The Empirical Simulation Technique (EST) (Borgeman et al.,

1992) was selected as the joint-probability analysis tool used to establish the relative costs and benefits of the proposed shore protection measures. The relative frequency and level of crosshore recession due to storm damage was quantified based on the SBEACH results for input into the EST analysis.

Table A-14

RECESSION RESULTS FOR SBEACH ANALYSIS

Reach (Storm)	Mean Recession (feet)[(1)]	Maximum Recession (feet)[(1)]
Pompano Beach/LBTS – Extratropical	64	98
Pompano Beach/LBTS – Tropical	90	215
Ft. Lauderdale – Extratropical	43	87
Ft. Lauderdale - -Tropical	78	188

(1) All recession distances are referenced to Mean High Water.

A-66. EST Input Development. The fourth step in the empirical simulation procedure involves preparation of the EST input files. These files contain input vectors, response vectors, and frequency of storm occurrence parameters. The values of the input parameters reflect the storm intensity. The response vector, in this application, quantifies the beach recession resulting from a given storm; and the storm frequency parameters are used to dictate the occurrence of extratropical and tropical storms throughout the multi-year life cycle analysis.

A-67. The characteristics of individual tropical storms were defined as: (a) tidal phase, (b) closest distance from the eye to the project site, (c) direction of propagation at time of closest proximity, (d) central pressure deficit, (e) forward velocity of the eye, (f) maximum wind speed, and (g) radius to maximum winds. As noted, the response to each storm was defined as the beach recession modeled by SBEACH. The frequency of occurrence of tropical events that impact the project beaches was previously estimated at 0.12 events per year. This corresponds to one event every 8.6 years.

A-68. Input vectors describing extratropical storms were defined as: (a) tidal phase, (b) storm duration, (c) maximum surge elevation, (d) wave height, and (e) wave period. The response vector was, of course, beach recession; and the frequency of occurrence of extratropical storms was previously estimated at 0.83 events per year.

A-69. EST Execution. The fifth step of the EST is the execution of empirical simulation procedures to generate multiple repetitions of multi-year scenarios in which storm events may occur. For this application, 100 repetitive simulations of a 200-year period of storm activity were performed. Simulations of extratropical and tropical storm histories were performed separately. For each simulation, a 200-year tabulation was generated to include the number of storms that occurred during each year and the corresponding beach recession. This information

provides the basis for calculation of return periods associated with various degrees of beach recession.

A-70. The final step in the EST procedure is analysis of results and presentation of those results in a format suitable for subsequent probabilistic analyses. In this case, the EST results were used as input for an economic evaluation of the impacts of beach recession. The economic model estimates damage and repair costs (related to storm-induced beach recession) that would be incurred over a multi-year period if no project improvements were constructed. The economic model makes no distinction between extratropical and tropical storms; therefore, the tropical and extratropical EST results were combined to generate a single storm-induced recession versus frequency of occurrence relationship.

The following algorithm was used to accomplish this combination of extratropical and tropical results:

For a given recession value: $T_c = (1/T_t+1/T_e)^{-1}$

Where: T_c denotes return period corresponding to the chosen recession
T_t represents the tropical storm return period corresponding to the chosen recession.
T_e equals the extratropical storm return period corresponding to the chosen recession.

A-71. As expected, due to their grater frequency of occurrence, the extratropical storms dominate the results corresponding to lower return periods. The greatest recession values were characteristic of the most severe tropical cyclones (i.e., hurricanes). Return periods associated with levels of combined tropical and extratropical storm-induced beach recession are provided in Figures A-5A and A-5B. Standard deviations of the expected recession for the range of return periods are also presented.

A-72. Summary of Cross-Shore Transport Analysis. The preceding information was provided to summarize how EST procedures were applied to this probabilistic analysis of cross-shore sediment transport in Broward County. This application generated frequency of occurrence relationships for storm-induced beach recession along Segment III of the Broward County shoreline, as tabulated above. The beach recession-frequency relationships were subsequently utilized as input to economic model for quantification of recession related damages to shorefront properties.

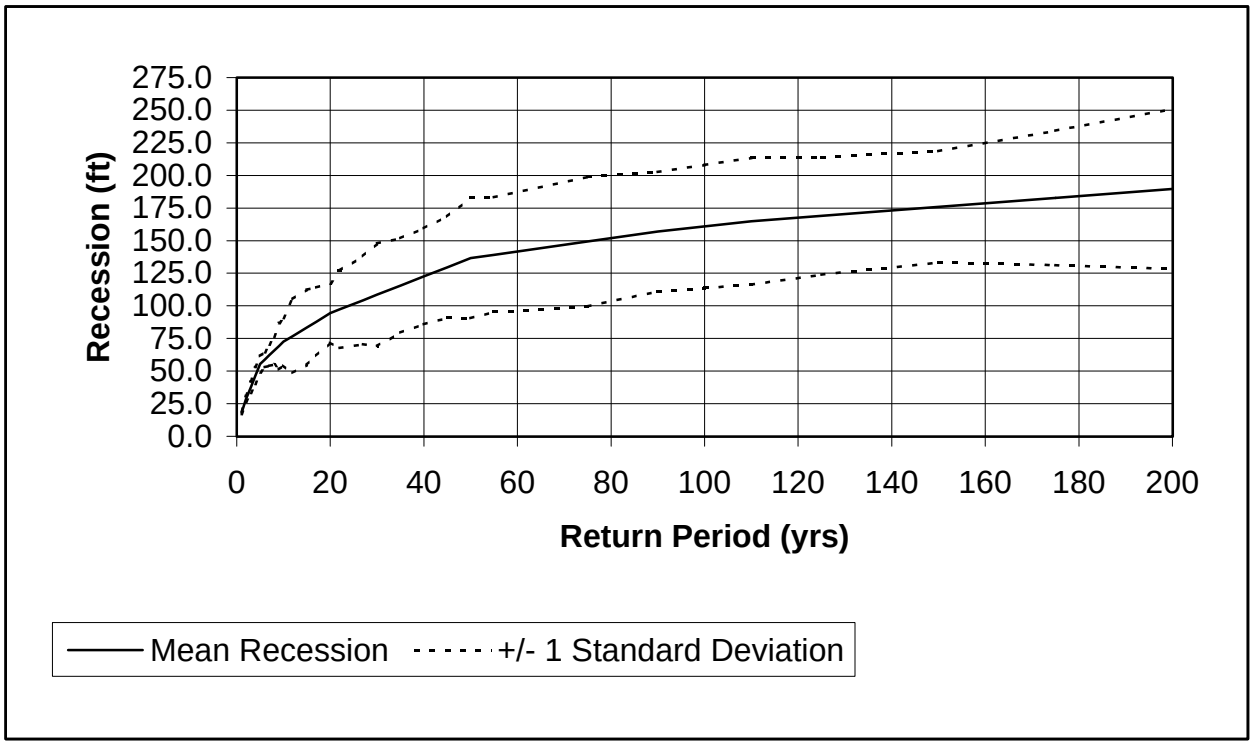


FIGURE A-5a

EST Recession (Pompano Beach/Lauderdale by the Sea)

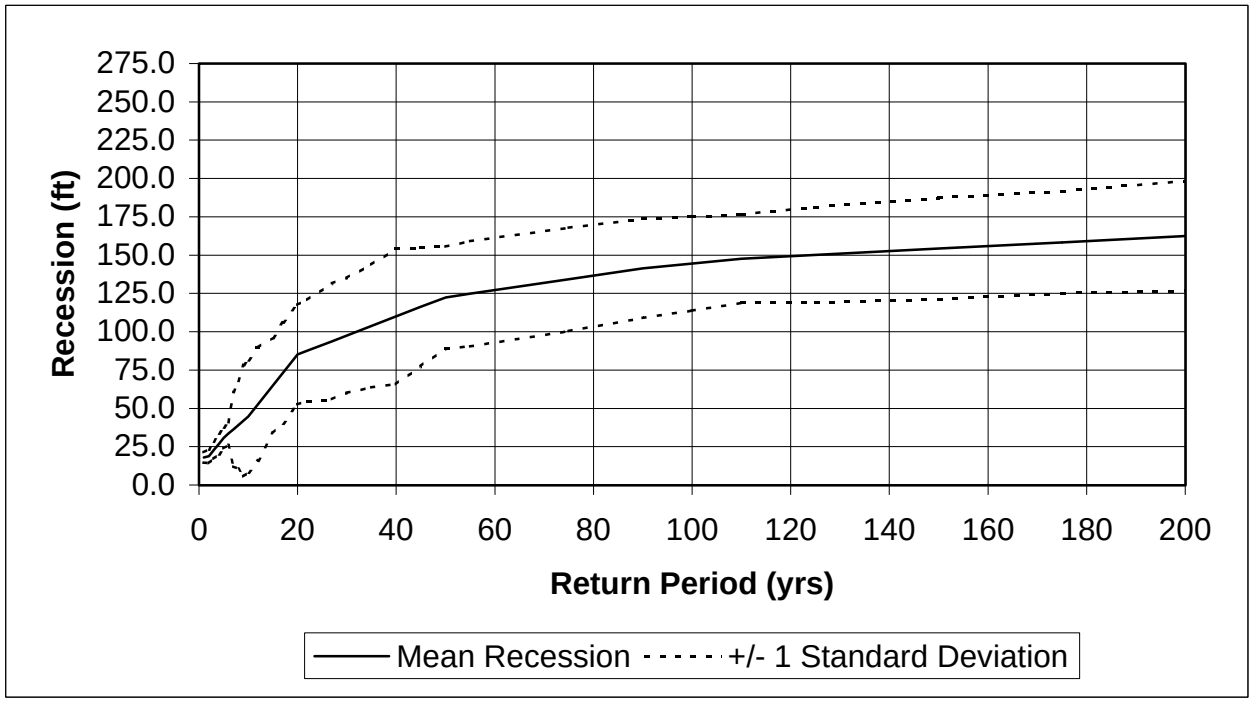


FIGURE A-5b

EST Recession (Ft. Lauderdale)

A-73. This section addresses the beach design and costs in terms of (1) reevaluation of the Federal project; (2) implementation of the reevaluated Federal Project; (3) a modification to the Federal project; (4) the combined reevaluated project with the modification and (5) a permittable combined project. To reevaluate the Federal project, 1970 conditions were assumed for analysis of the preliminary NED plan for Pompano Beach/Lauderdale-by-the-Sea (R26-R53). The predicted conditions in 2002 (planned construction year) were used to determine the amount of fill necessary to implement the reevaluated preliminary NED plan in Pompano Beach/Lauderdale-by-the-Sea. Ft. Lauderdale is a modification to the Federal project, so fill volumes and costs were determined based upon an independent preliminary NED plan to be constructed in 2002 along with modified reevaluated Federal project (Figure A-6).

REEVALUATION OF THE FEDERAL PROJECT (POMPANO BEACH/ LAUDERDALE-BY-THE-SEA)

A-74. Project Length. The Federal project extends from Hillsboro Inlet (R-26) to the south through Lauderdale-by-the-Sea (LBTS) (R53) (Figure A-6). This is a total of 5.4 miles and includes Reaches 1 and 2.

A-75. Project Baseline. The project baseline for Pompano Beach (R-26 to R-49) is the 1970 MHW for the area from R32 to just south of R48 and the 1981 Erosion Control Line (ECL) from R26 to R32 and from R48 to R49. The ECL for LBTS (R50-53) was established as the 1983 MHW. Using these two ECLs to construct a single project will result in an inefficient, costly project. The project would have excessively large MHW extensions for LBTS, compared to Pompano Beach, which will result in adverse diffusion effects and excessive hardbottom coverage. To alleviate this problem, a baseline is used for LBTS, which is straight line extension of the Pompano Beach ECL to FDEP Monument R53. This baseline was discussed with the Jacksonville District prior to use.

A-76. Berm Elevations. The authorized berm elevation for this project is +9.0 feet NGVD, which is consistent with the natural berm elevation.

A-77. Beach Widths. While the beach width is optimized (NED plan) in Appendix C for the re-evaluation of the Federal project, design fill volumes, advance nourishment, hard bottom coverage, and project costs are needed for a variety of design widths. The beach widths used are in terms of ECL/baseline extensions and are from 75 feet to 125 feet in 25 foot increments.

A-78. Design Fill Volume. Based on guidance provided by the National Research Council's report on beach nourishment (National Research Council, 1995), design volumes presented here are based on nourishment of the entire active profile. The design volumes are calculated using profile translation. The design volumes for the above beach widths are shown in Table A-15.

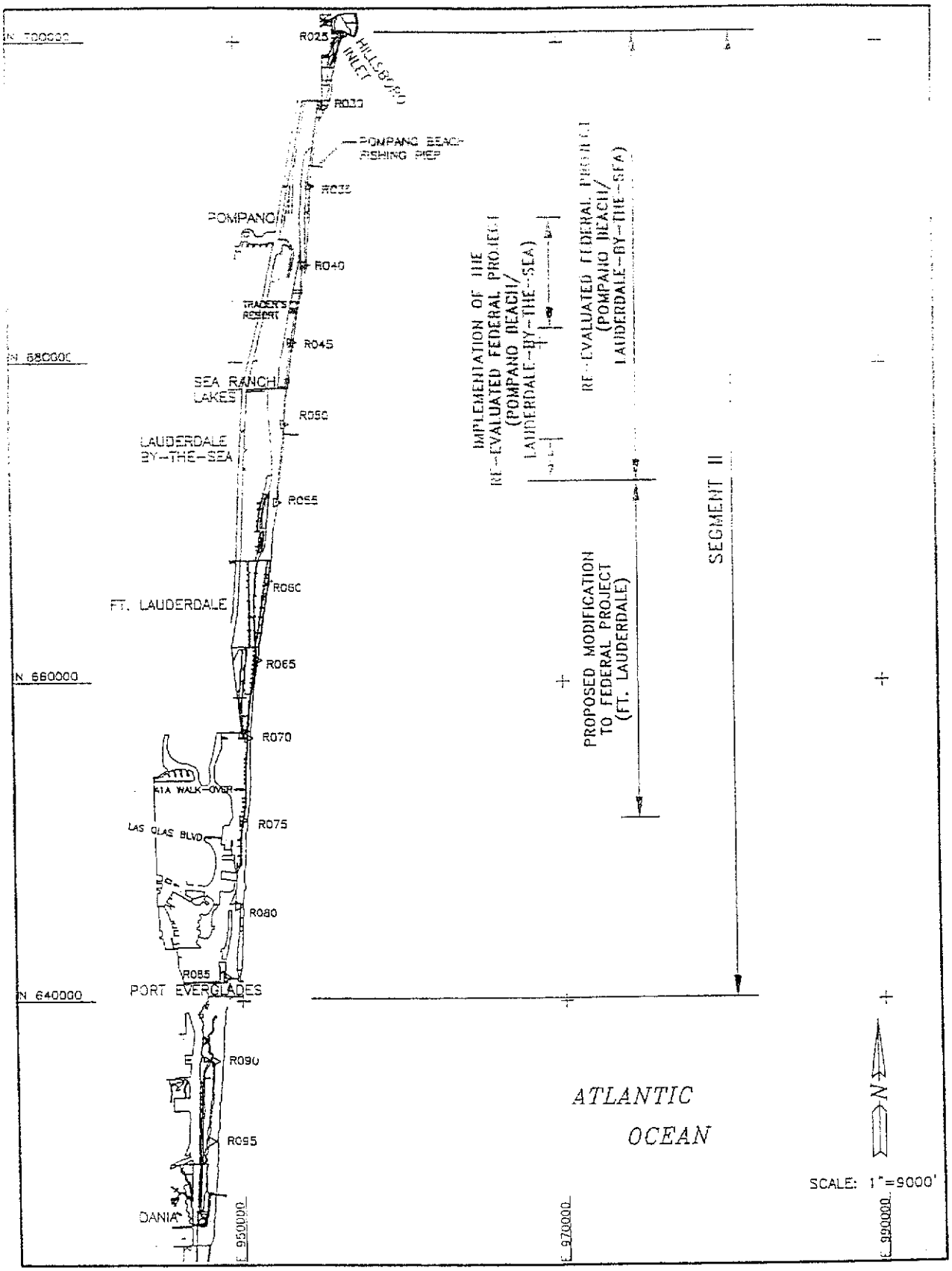


FIGURE A-6

RE-EVALUTED FEDERAL PROJECT AND PROPOSED MODIFICATIONS TO THE FEDERAL PROJECT

TABLE A-15

RE-EVALUATION OF THE FEDERAL PROJECT
DESIGN AND ADVANCE FILL VOLUMES AND HARD BOTTOM COVERAGE

ECL/Baseline Extension (ft)	Nourishment Interval (yrs)	Design Fill (cy)	Advance Fill (cy)	Hardbottom Coverage (acres)	Annualized Costs
75	5	1,857,000	935,000	6.7	$3,516,000
100	5	2,476,000	935,000	12.2	$3,984,000
125	5	3,096,000	935,000	20.9	$4,530,000

A-79. Advance Nourishment. The advance nourishment needed to maintain the design width is based upon volumetric erosion rates from 1983 to 1998 (Figure A-3a). The volumetric erosion rates used to determine the amount of advance nourishment utilize only the erosive profile lines because profile accretion is not an adverse effect on maintaining the design width. The profile erosion rates are smoothed using a 3 point running average so that advance fill can be placed more uniformly to prevent adverse fill diffusion and excessive hardbottom coverage. The background erosion and end loss erosion are 15,000 cy/yr and 172,000 cy/yr, respectively.

A-80. Since sand characteristics are not known for the beach or borrow areas used in 1970, overfill is estimated and included as a part of the design fill. The overfill ratio used applied to the design volumes is 1.15. The total advance nourishment needed for each design extension is in Table A-15 and is based on a 5 year nourishment interval. Nourishment intervals were optimized in Sub-Appendix A-2.

A-81. Hardbottom Coverage. The hardbottom coverage between R26 and R53 is based upon the DOC for each beach profile line and the hardbottom communities mapped in 1999 by Broward County. The expected hardbottom coverage for each design extension is shown in Table A-15.

A-82. Project Costs. Conservative price levels are used for the dredging of beachfill material. The mobilization/demobilization cost is $1,000,000 and the unit cost of sand is $6.50 or $8.50/CY depending on the renourishment cycle (Table A-16). This is based on hopper dredging with rock removal. It is estimated that the unit cost of sand for the initial construction in 1970 was $6.50/CY. For subsequent renourishments prior to the year 2000, the unit cost of sand is estimated at $6.50/CY. The renourishment scheduled for the year 2002 will be using borrow areas that are further away from the project. Therefore, the unit price for sand is $8.50/CY.

A-83. Costs for project engineering and design, construction administration, maintenance, and project monitoring are estimated as a percentage of contract costs. For the initial nourishment the percentage is 10% and increases to 20% for subsequent renourishments (Table A-16). A contingency of 15% is included for all cost estimates. Table A-15 shows the annualized cost estimates for each design width used in reevaluating the Federal Project, the detailed cost estimates are shown in Sub-Appendix A-2.

TABLE A-16

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
5 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Nourishment	0												
Mobilization/Demobilization		$1,000,000	1	$1,000,000									
Beach Fill		$6.50	3,411,810	$22,176,765									
Beach Tilling (ac)		$300	84.7	$25,422									
Hard Bottom Mitigation (ac)		$300,000	12.2	$3,660,000									
1st Renourishment	5												
Mobilization/Demobilization		$1,000,000	1		$1,000,000								
Beach Fill		$6.50	935,400		$6,080,100								
Beach Tilling (ac)		$300	84.7		$25,422								
Hard Bottom Mitigation (ac)					$0								
2nd Renourishment	10												
Mobilization/Demobilization		$1,000,000	1			$1,000,000							
Beach Fill		$6.50	935,400			$6,080,100							
Beach Tilling (ac)		$300	84.7			$25,422							
Hard Bottom Mitigation (ac)						$0							
3rd Renourishment	15												
Mobilization/Demobilization		$1,000,000	1				$1,000,000						
Beach Fill		$6.50	935,400				$6,080,100						
Beach Tilling (ac)		$300	84.7				$25,422						
Hard Bottom Mitigation (ac)							$0						
4th Renourishment	20												
Mobilization/Demobilization		$1,000,000	1					$1,000,000					
Beach Fill		$6.50	935,400					$6,080,100					
Beach Tilling (ac)		$300	84.7					$25,422					
Hard Bottom Mitigation (ac)								$0					
5th Renourishment	25												
Mobilization/Demobilization		$1,000,000	1						$1,000,000				
Beach Fill		$6.50	935,400						$6,080,100				
Beach Tilling (ac)		$300	84.7						$25,422				
Hard Bottom Mitigation (ac)									$0				
6th Renourishment	30												
Mobilization/Demobilization		$1,000,000	1							$1,000,000			
Beach Fill		$8.50	935,400							$7,950,900			
Beach Tilling (ac)		$300	84.7							$25,422			
Hard Bottom Mitigation (ac)										$0			
7th Renourishment	35												
Mobilization/Demobilization		$1,000,000	1								$1,000,000		
Beach Fill		$8.50	935,400								$7,950,900		
Beach Tilling (ac)		$300	84.7								$25,422		
Hard Bottom Mitigation (ac)											$0		
8th Renourishment	40												
Mobilization/Demobilization		$1,000,000	1									$1,000,000	
Beach Fill		$8.50	935,400									$7,950,900	
Beach Tilling (ac)		$300	84.7									$25,422	
Hard Bottom Mitigation (ac)												$0	
9th Renourishment	45												
Mobilization/Demobilization		$1,000,000	1										$1,000,000
Beach Fill		$8.50	935,400										$7,950,900
Beach Tilling (ac)		$300	84.7										$25,422
Hard Bottom Mitigation (ac)													$0
Subtotal				$26,862,187	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$8,976,322	$8,976,322	$8,976,322	$8,976,322
Contingency		15%		$4,029,328	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,346,448	$1,346,448	$1,346,448	$1,346,448
Subtotal Contract Cost				$30,891,515	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$10,322,771	$10,322,771	$10,322,771	$10,322,771
		Percentage of Contract Costs											
Nourishment	0												
E&D+S&A		10%	1	$3,089,152									
1st Renourishment	5												
E&D+S&A		20%	1		$1,634,270								
2nd Renourishment	10												
E&D+S&A		20%	1			$1,634,270							
3rd Renourishment	15												
E&D+S&A		20%	1				$1,634,270						
4th Renourishment	20												
E&D+S&A		20%	1					$1,634,270					
5th Renourishment	25												
E&D+S&A		20%	1						$1,634,270				
6th Renourishment	30												
E&D+S&A		20%	1							$2,064,554			
7th Renourishment	35												
E&D+S&A		20%	1								$2,064,554		
8th Renourishment	40												
E&D+S&A		20%	1									$2,064,554	
9th Renourishment	45												
E&D+S&A		20%	1										$2,064,554
Total Construction Cost				$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Construction Cost	$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325
Interest During Construction	$178,208	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$34,158,874	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325
Present Worth of Each Construction	$34,158,874	$7,284,279	$5,411,256	$4,019,847	$2,986,215	$2,218,362	$2,081,836	$1,546,528	$1,148,866	$853,455
Total Present Worth	$61,709,519									

Average Annual Cost	$3,983,595
Interest Rate	6.125%

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P:\Broward\535056 Federal Design Document Revisions\Engineering_Appx_A\[Table-A16-pomp-lbts ned plan.xls]5 Year (2)

A-84. Based upon economic considerations, an ECL extension of 100 feet, the preliminary NED plan, was found to provide the optimum difference between annualized project costs and primary benefits. The NED plan was calculated using 1970 conditions, but under present conditions there is already sufficient beach width in some areas to maintain the preliminary NED plan width through the next expected nourishment interval. The only two areas within the Federal project which would require renourishment are from R-37 to R-42 and R-52 to R53 (Plates 1-7). Table A-17 shows the proposed beach extension, including advance nourishment, from the 1998 MHW. The preliminary NED design width is a 100 foot ECL/baseline extension (Appendix C).

A-85. Design Fill Volume. Based on guidance provided by the National Research Council's report on beach nourishment (National Research Council, 1995), design volumes presented here are based on nourishment of the entire active profile. The design volumes include 77,220 cy to restore and translate the profile. The design volume also takes into account the amount of material that is expected to be lost from 1998 to 2002 which is 39,900 cy. The design volumes for each profile are shown in Table A-17.

A-86. Advance Nourishment. The advance nourishment needed to maintain the design width is based upon the volumetric erosion rates from 1983 to 1998 (Figure A-3a). The volumetric erosion rates used to determined the amount of advance nourishment utilize only the erosive profile lines, because profile accretion is not an adverse effect on maintaining the design width. The profile erosion rates are smoothed, using a 3 point running average, so that advance fill can be placed more uniformly to prevent adverse diffusion and excessive hardbottom coverage. For the two fill areas, the background erosion rate is 13,200 cy/yr.

A-87. The advance nourishment also takes into account the amount of fill needed to maintain the design width through the 10-year renourishment interval as a result of diffusive end losses. Project diffusion is based upon the design's planform response to the wave climate (Campbell et al., 1992). The portion of the advance nourishment that is for project diffusion is 106,500 cy. Due to the compatibility of the borrow material to the existing beach material, no overfill is necessary. The total advance nourishment needed is 239,000 cy. (Table A-17).

A-88. Fill Volume Behind ECL. For the Federal project, only fill in Lauderdale-by-the-Sea will be placed behind the ECL. The total amount of fill behind the ECL is 9,100 cy (Table A-17).

A-89. Hardbottom Coverage. The hardbottom coverage is based upon the DOC for each beach profile line, the expected profile response, and the hardbottom location mapped in 1999 by

Table A-17

Pompano Beach/Lauderdale-by-the-Sea
Beach Extensions, Fill Volumes, and Hardbottom Coverage
To Implement Preliminary NED Plan in 2002

Monument	Effective Distance (ft)	MHW Extension (including Adv. Fill) (ft)	Design Volume (CY)	Advance Fill (CY)	Fill Behind ECL (CY)	Hardbottom Coverage (acres)
R-36	1,016	0.0	0	0	0	0.0
R-37	915	40.9	4,108	33,273	0	0.9
R-38	948	70.1	18,044	39,913	0	1.7
R-39	1,005	69.9	19,587	39,673	0	0.0
R-40	971	59.6	18,597	33,904	0	1.7
R-41	942	40.4	1,062	31,027	0	0.0
T-42	1,015	38.0	6,957	23,446	0	0.4
R-43	930	0.0	0	0	0	0.0
R-44	1,001	0.0	0	0	0	0.0
R-45	1,044	0.0	0	0	0	0.0
CR-46	789	0.0	0	0	0	0.0
R-47	972	0.0	0	0	0	0.0
R-48	1,205	0.0	0	0	0	0.0
R-49	1,129	0.0	0	0	0	0.0
R-50	1,000	0.0	0	0	0	0.0
R-51	973	0.0	0	0	0	0.0
T-52	967	31.9	24,340	9,094	5,520	1.1
R-53	978	60.0	24,441	28,621	3,605	0.5
Total	17,800		117,137	238,951	9,125	6.4

Broward County. The total coverage for Pompano Beach/Lauderdale-by-the-Sea is 6.4 acres (Table A-17).

A-90. Project Costs. Costs were determined to implement the preliminary NED plan width of a 100 foot ECL extension under present conditions. The total costs to build and maintain this preliminary NED plan for 18 years, the remainder of the 50 year project life, are adjusted to present value then amortized over 18 years. The costs to maintain the project include one renourishment 10 years after construction. The interest rate used is 6.125%. The annualized cost for this modification to the reevaluated Federal project is $967,000 (Table A-18).

A-91. Conservative price levels are used for the dredging of material. The mobilization/ demobilization cost is $1,000,000 and the unit cost of sand is $8.50/CY. The dredging costs are based on the current market, account for dredging during the winter season, and filtering of dredged material. There are adequate sediment reserves (Appendix E) to assume constant unit price levels.

A-92. A contingency of 15% is included for all cost estimates. Costs to perform geotechnical investigations; secure easements; perform environmental monitoring; and engineering, design, construction supervision, and administration are shown in Table A-18. Sand production is estimated at 300,000 cy/month.

MODIFICATION TO THE FEDERAL PROJECT (FT. LAUDERDALE)

A-93. A recommended plan is presented here as a modification to the Federal project. Ft. Lauderdale has never been nourished and it is recommended that it be made a part of the Federal project. A detailed description of this recommendation is presented below and shown in Plates 7–14. The design and costs for the optimization of Ft. Lauderdale modification are presented.

A-94. Project Length. Approximately 4.0 miles of Ft. Lauderdale's 5.9 mile shoreline are erosional and initially considered for nourishment (Table A-6). Areas south of R-74 are mildly accretional. The north limit of the proposed beach fill is located at FDEP monument R-53. The southern limit of the renourishment area is defined as R-74.

A-95. Taper Section. The south end of the proposed fill will require a 4,000 foot taper section beginning at R-74. The north end of this modification to the Federal Project will transition into the existing Federal Project at Lauderdale-by-the-Sea (R-53). The taper section was optimized using the guidance described in CETN-II-6 (USACE, 1982). The optimization is based on the transition length to the construction template, annual cost of renourishment, and annualized cost of the transition. Renourishment intervals of 10 and 11 years were used and the advance nourishment quantities used are described in a following section. Increments of 1000 feet were used. Table A-19 shows the annualized costs for various taper lengths. The 4,000 foot taper is optimal.

TABLE A-18

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 10 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	356,088	$3,026,746	
	10	$8.50	212,456		$1,805,873
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	6.4	$1,919,653	
Subtotal				$5,951,730	$2,811,205
Contingency		15%		$892,760	$421,681
Subtotal Contract Cost				$6,844,490	$3,232,885
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$7,989,093	$4,252,488

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$7,989,093	$4,252,488
Interest During Construction	$39,873	$0
Total Investment Cost	$8,028,965	$4,252,488
Present Worth of Each Construction	$8,028,965	$2,346,746
Total Present Worth	$10,375,711	

Average Annual Cost	$967,279
Interest Rate	6.125%

TABLE A-19

MODIFICATION TO THE FEDERAL PROJECT
OPTIMIZATION OF TAPER LENGTH

Taper Length (feet)	Annualized Costs 10 Year	Annualized Costs 11 Year
2,000	$767,000	$750,000
3,000	$645,000	$624,000
4,000	**$624,000**	**$598,000**
5,000	$643,000	$612,000
6,000	$682,000	$647,000
7,000	$733,000	$693,000

Note: Least cost alternative shown in bold.

A-96. A non-federal preferred option of a 1,000 foot taper will be exercised when implementing the project. A 4,000 foot taper will cover an acre of additional hard bottom, which results in increased mitigation costs. The difference in sand volume between the 1,000 foot taper and 4,000 foot taper has been included in the advance nourishment. Using the 1000 foot taper while placing the 4,000 foot taper volume within the project limits will minimize hardbottom impacts while maintaining project integrity.

A-97. Project Baseline. Since an ECL has not been established, the 1998 MHW (+1.9 feet NGVD) will be used as the project baseline.

A-98. Berm Elevations. The authorized berm elevation for this project is +9.0 feet NGVD, which is consistent with the natural berm elevation.

A-99. Beach Widths. While the beach width is optimized (preliminary NED plan) in Appendix C for this modification to the Federal project, design fill volumes, advance nourishment, hard bottom coverage, and project costs are needed for a variety of design widths. The beach widths used are in terms of baseline extensions and are from 1 foot to 50 feet in 25 foot increments. The preliminary NED plan for this modification was found to be a 25 foot extension of the baseline (Appendix C).

A-100. Design Fill Volume. Based on guidance provided by the National Research Council's report on beach nourishment (National Research Council, 1995), design volumes presented here are based on nourishment of the entire active profile. The design volumes are calculated using profile translation. Included in the design volume is 75,500 cy to account for 1998-2002 expected erosion. The design volumes for the above beach widths are shown in Table A-20.

TABLE A-20
MODIFICATION TO THE FEDERAL PROJECT
FILL VOLUMES AND HARD BOTTOM COVERAGE

ECL/ Baseline Extension (ft)	South Project Limit	Nourishment Interval (yrs)	Design Fill (cy)	Advance Fill (cy)	Fill Behind Baseline (cy)	Hardbottom Coverage (acres)	Annualized Cost
1	R-74	12	120,700	383,300	189,400	4.0	$1,016,000
25	R-74	11	556,400	364,400	189,400	6.5	$1,574,000
50	R-74	10	1,010,200	345,500	189,400	10.4	$2,202,000
25	R-79	12	670,600	422,800	237,500	14.4	$2,037,000
25	R-84	12	768,700	457,300	278,700	15.3	$2,231,000

A-101. Advance Nourishment. The advance nourishment needed to maintain the design width is based upon volumetric erosion rates from 1993 to 1998 (Figure A-3b). The volumetric erosion rates used to determine the amount of advance nourishment utilize only the erosive profile lines because profile accretion is not an adverse effect on maintaining the design width. The profile erosion rates are smoothed, using a 3 point running average, so that advance fill can be placed more uniformly to prevent adverse diffusion and excessive hardbottom coverage. The advanced nourishment rate is 18,900 cy/yr. The advance nourishment necessary for the project also takes into account the diffusive end losses. The diffusion for the R53-R74 project (127,100 cy) includes the volume for a 4,000 foot taper. Project diffusion is based upon the design's planform response to the wave climate (Campbell et al., 1992).

A-102. Cost tables verifying optimal intervals are shown in Sub-Appendix A-3. Based upon the different sand characteristics between the existing beach and the borrow material, addressed in a previous section of this appendix, the overfill needed for this modification to the Federal project is 30,000 cy (1.4 cy/ft) for the R53 to R74 project.

A-103. Fill Volume Behind Baseline. The total amount of fill behind the baseline is 189,400 cy (Table A-20) for the R53-R74 project.

A-104. Hardbottom Coverage. The hardbottom coverage is based upon the DOC for each beach profile line and the hardbottom location mapped in 1999 by Broward County. The total coverage for Ft. Lauderdale is 6.5 acres (Table A-20) for the 25 foot wide, 11 year interval, project.

A-105. Project Costs. Conservative price levels are used for the dredging of material. Since this modification is being evaluated independently of the Pompano/Lauderdale-by-the-Sea project, the mobilization/demobilization cost is $1,000,000. Since Ft. Lauderdale is further away from the borrow areas, the hopper dredge will have longer distances to travel. Consequently, the unit cost of sand is $9.00/CY. The dredging costs are based on the current market, account for dredging during the winter season, and filtering of dredged material. There are adequate

sediment reserves (Appendix E) to assume constant unit price levels. A contingency of 15% is added to any contract cost.

A-106. Costs for project engineering and design, construction administration, maintenance, and project monitoring are estimated as a percentage of contract costs. For initial nourishment the E&D and S&A percentage is 10% and increases to 20% for the subsequent renourishment (Table A-21). A contingency of 15% is included for all cost estimates. Sand production is estimated at 300,000 cy/month. Detailed cost estimates for each design width are shown in Sub-Appendix A-3, but are summarized in Table A-20. Appendix C determines that the 25 foot width project is the optimal project.

BEACH LENGTHS

A-107. As discussed previously, the existing beach is erosional from R53 through R-74 in Ft. Lauderdale; therefore, if sufficient benefits exist (Appendix C), this is the minimum length of beach that should be constructed. To determine the optimal length (preliminary NED plan) additional lengths were considered with 5,000 foot increments. The maximum length considered extends to the north jetty at Port Everglades. The design parameters and costs are summarized in Table A-20. Hardbottom coverages for each length of project are also shown. Optimization of the intervals is shown in Appendix A-4. Optimization of the project length, discussed in Appendix C, indicates that the R-53 to R-74 project is the preliminary NED length. Hardbottom impacts are also minimized.

COMBINED REEVALUATED AND MODIFIED FEDERAL PROJECT

A-108. The total cost of the reevaluated Pompano Beach/Lauderdale-by-the-Sea project over a 50-year life and the Ft. Lauderdale project over a 18-year life is shown in Table A-22. This analysis combines the project costs at the individual optimal nourishment intervals. The annual cost of the preliminary NED plan is $4,146,000.

IMPLEMENTATION OF THE COMBINED REEVALUATED FEDERAL PROJECT

A-109. While the previous section presented the costs for the project over a 50-year life, implementation of the project will occur over the remaining 18 years of the authorized life. There are opportunities for cost saving through shared mobilization efforts and identifying a combined nourishment interval. It should be noted, that due to the change in nourishment interval, the hardbottom coverage reduces to 6.4 and 6.4 acres, for Pompano Beach/Lauderdale-by-the-Sea and Ft. Lauderdale, respectively. Based upon the annualized costs of the recommended modified, reevaluated Federal project, the optimum renourishment interval is 10 years, with an annualized cost of $2,355,000 (Table A-23). Detailed cost estimates for various nourishment intervals are shown in Sub-Appendix A-5. The renourishment interval was determined using the fill volume and costs estimates, to implement the preliminary NED plans for both Pompano Beach/Lauderdale-by-the-Sea (100 foot extension of the ECL/baseline) and Ft. Lauderdale (25 foot baseline extension). These volume calculations and cost estimates were addressed in previous sections of this appendix. The annualized cost for each renourishment interval is shown in Table A-24, and detailed cost tables are shown in Sub-Appendix A-5.

TABLE A-21

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	920,780	$8,287,023	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.5	$1,953,293	
Subtotal				$11,243,951	$3,603,282
Contingency		15%		$1,686,593	$540,492
Subtotal Contract Cost				$12,930,544	$4,143,774
Nourishment					
E&D+S&A		10%	1	$1,293,054	
1st Renourishment					
E&D+S&A		20%	1		$828,755
Total Construction Cost				$14,223,598	$4,972,528

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$14,223,598	$4,972,528
Interest During Construction	$71,696	$0
Total Investment Cost	$14,295,294	$4,972,528
Present Worth of Each Construction	$14,295,294	$2,585,726
Total Present Worth	$16,881,020	

Average Annual Cost	$1,573,739
Interest Rate	6.125%

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TABLE A-22

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea and Ft. Lauderdale
100'/25' Added Shoreline Width (ft)
5/11 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year										
				1970	1975	1980	1985	1990	1995	2000	2002	2005	2010	2013	2015
Nourishment	0														
Mobilization/Demobilization		$1,000,000	1	$1,000,000											
Beach Fill		$6.50	3,411,810	$22,176,765											
Beach Tilling (ac)		$300	84.7	$25,422											
Hard Bottom Mitigation (ac)		$300,000	12.2	$3,660,000											
1st Renourishment	5														
Mobilization/Demobilization		$1,000,000	1		$1,000,000										
Beach Fill		$6.50	935,400		$6,080,100										
Beach Tilling (ac)		$300	84.7		$25,422										
Hard Bottom Mitigation (ac)					$0										
2nd Renourishment	10														
Mobilization/Demobilization		$1,000,000	1			$1,000,000									
Beach Fill		$6.50	935,400			$6,080,100									
Beach Tilling (ac)		$300	84.7			$25,422									
Hard Bottom Mitigation (ac)						$0									
3rd Renourishment	15														
Mobilization/Demobilization		$1,000,000	1				$1,000,000								
Beach Fill		$6.50	935,400				$6,080,100								
Beach Tilling (ac)		$300	84.7				$25,422								
Hard Bottom Mitigation (ac)							$0								
4th Renourishment	20														
Mobilization/Demobilization		$1,000,000	1					$1,000,000							
Beach Fill		$6.50	935,400					$6,080,100							
Beach Tilling (ac)		$300	84.7					$25,422							
Hard Bottom Mitigation (ac)								$0							
5th Renourishment	25														
Mobilization/Demobilization		$1,000,000	1						$1,000,000						
Beach Fill		$6.50	935,400						$6,080,100						
Beach Tilling (ac)		$300	84.7						$25,422						
Hard Bottom Mitigation (ac)									$0						
6th Renourishment	30														
Mobilization/Demobilization		$1,000,000	1							$1,000,000					
Beach Fill		$6.50	935,400							$7,950,900					
Beach Tilling (ac)		$300	84.7							$25,422					
Hard Bottom Mitigation (ac)										$0					
7th Renourishment	35														
Mobilization/Demobilization		$1,000,000	1									$1,000,000			
Beach Fill		$8.50	935,400									$7,950,900			
Beach Tilling (ac)		$300	84.7									$25,422			
Hard Bottom Mitigation (ac)												$0			
8th Renourishment	40														
Mobilization/Demobilization		$1,000,000	1										$1,000,000		
Beach Fill		$8.50	935,400										$7,950,900		
Beach Tilling (ac)		$300	84.7										$25,422		
Hard Bottom Mitigation (ac)													$0		
9th Renourishment	45														
Mobilization/Demobilization		$1,000,000	1												$1,000,000
Beach Fill		$8.50	935,400												$7,950,900
Beach Tilling (ac)		$300	84.7												$25,422
Hard Bottom Mitigation (ac)															$0
Addition of Ft Lauderdale	32														
Mobilization/Demobilization		$1,000,000	1								$1,000,000				
Beach Fill		$9.00	920,760								$8,287,023				
Beach Tilling (ac)		$300	12.1								$3,635				
Hard Bottom Mitigation (ac)		$300,000	6.5								$1,953,293				
Renourishment Ft Lauderdale	43														
Mobilization/Demobilization		$1,000,000	1											$1,000,000	
Beach Fill		$9.00	288,850											$2,599,646	
Beach Tilling (ac)		$300	12.1											$3,635	
Hard Bottom Mitigation (ac)														$0	
Subtotal				$26,662,187	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$8,976,322	$11,243,951	$8,976,322	$8,976,322	$3,603,282	$8,976,322
Contingency		15%		$4,029,328	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,346,448	$1,686,593	$1,346,448	$1,346,448	$540,492	$1,346,448
Subtotal Contract Cost				$30,691,515	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$10,322,771	$12,930,544	$10,322,771	$10,322,771	$4,143,774	$10,322,771
		Percentage of Contract Costs													
Nourishment	0														
E&D+S&A		10%	1	$3,089,152											
1st Renourishment	5														
E&D+S&A		20%	1		$1,634,270										
2nd Renourishment	10														
E&D+S&A		20%	1			$1,634,270									
3rd Renourishment	15														
E&D+S&A		20%	1				$1,634,270								
4th Renourishment	20														
E&D+S&A		20%	1					$1,634,270							
5th Renourishment	25														
E&D+S&A		20%	1						$1,634,270						
6th Renourishment	30														
E&D+S&A		20%	1							$2,064,554					
7th Renourishment	35														
E&D+S&A		20%	1									$2,064,554			
8th Renourishment	40														
E&D+S&A		20%	1										$2,064,554		
9th Renourishment	45														
E&D+S&A		20%	1												$2,064,554
Addition of Ft Lauderdale	32														
E&D+S&A		10%	1								$1,293,054				
1st Renourishment	43														
E&D+S&A		20%	1											$828,755	
Total Construction Cost				$33,880,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$14,223,598	$12,387,325	$12,387,325	$4,972,528	$12,387,325

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year										
	1970	1975	1980	1985	1990	1995	2000	2002	2005	2010	2013	2015
Construction Cost	$33,880,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$14,223,598	$12,387,325	$12,387,325	$4,972,528	$12,387,325
Interest During Construction	$178,206	$0	$0	$0	$0	$0	$0	$71,696	$0	$0	$0	$0
Total Investment Cost	$34,153,874	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$14,295,294	$12,387,325	$12,387,325	$4,972,528	$12,387,325
Present Worth of Each Construction	$34,153,874	$7,384,279	$5,411,256	$4,019,647	$2,966,215	$2,218,382	$2,081,836	$2,133,175	$1,546,523	$1,148,866	$385,848	$853,455
Total Present Worth							$64,226,542					

Average Annual Cost	$4,146,208
Interest Rate	6.125%

TABLE A-23

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 10 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	356,088	$3,026,746	
	10	$8.50	212,456		$1,805,873
Reach 3 Beach Fill (cy)	0	$9.00	901,893	$8,117,037	
	10	$9.00	307,737		$2,769,633
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	12.8	$3,829,062	
Subtotal				$16,081,811	$5,684,472
Contingency		15%		$2,412,272	$852,671
Subtotal Contract Cost				$18,494,083	$6,537,143
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$20,551,162	$8,344,222

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$20,551,162	$8,344,222
Interest During Construction	$104,105	$0
Total Investment Cost	$20,655,267	$8,344,222
Present Worth of Each Construction	$20,655,267	$4,604,779
Total Present Worth	$25,260,046	

Average Annual Cost	$2,354,877
Interest Rate	6.125%

TABLE A-24
RENOURISHMENT INTERVAL OPTIMIZATION
FOR THE IMPLEMENTATION OF THE
RE-EVALUATED FEDERAL PROJECT

Nourishment Interval (Years)	Project Costs
9	$2,356,000
10	**$2,355,000**
11	$2,358,000
12	$2,364,000
13	$2,373,000
14	$2,385,000
15	$2,400,000

Note: Least cost alternative shown in bold.

A-110. The preliminary NED plan was reviewed with the State of Florida and Federal resource agencies to determine if the plan was permittable. After consultation with those agencies, it was determined that the preliminary NED plan was not permittable due to excessive equilibrium toe of fill impacts, but with some modifications to avoid impacts to nearshore hardbottoms and avoid potential impacts to hardbottoms adjacent to the borrow areas, the plan could be permittable. The modifications generally include the following:

a. A reduction in the advanced nourishment volume between R-36 and R-42.
b. A reduction in the advanced nourishment volume between R-51 and R-71.
c. A reduction in the Ft. Lauderdale design width from 25 feet to 20 feet.
d. A shortening of the project length from R-74 to R-71 (about 3000 feet).
e. Elimination of Borrow Area V and VII (Appendix E).
f. Modification of the other borrow areas, as needed, to increase the distance from the borrow area to specific hardbottom resources (Appendix E).

A-111. The total beach fill in northern Pompano Beach (R-36 to R-42) was reduced to 198,000 cy. Based on 2001 beach profiles, approximately 26,000 cy is required to restore the 100 foot design section. The remaining 172,000 cy will provide 6 years of advanced nourishment accounting for background erosion, end losses and overfill. Approximately 3.0 acres of nearshore hardbottom will be impacted by the equilibrium toe of fill. The cost of implementing this 6 year nourishment interval for the remaining 18 years of project life is shown in Table A-25. The annual cost is $1,094,000. This is the NED plan for Pompano Beach/Lauderdale-By-The-Sea.

A-112. The Ft. Lauderdale segment (R-53 to R-71 with tapers to adjacent beaches) was reduced to 732,000 cy. This required a reduction of the design section from 25 feet to 20 feet (extension of the 1998 shoreline). Based on the 2001 beach profiles approximately 476,000 cy is required to establish the design section. The remaining 256,000 cy will provide 6 years of advanced nourishment for background erosion, end losses and overfill. Approximately 3.0 acres of

TABLE A-25
Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
6 Year Renourishment Interval
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2008	2014
Nourishment	0					
Mobilization/Demobilization		$1,000,000	1	$1,000,000		
Beach Fill		$8.50	198,000	$1,683,000		
Beach Tilling (ac)		$300	26.0	$7,800		
Hard Bottom Mitigation (ac)		$300,000	3.0	$900,000		
1st Renourishment	6					
Mobilization/Demobilization		$1,000,000	1		$1,000,000	
Beach Fill		$8.50	171,000		$1,453,500	
Beach Tilling (ac)		$300	22.0		$6,600	
Hard Bottom Mitigation (ac)			0.0		$0	
2nd Renourishment	12					
Mobilization/Demobilization		$1,000,000	1			$1,000,000
Beach Fill		$8.50	171,000			$1,453,500
Beach Tilling (ac)		$300	22.0			$6,600
Hard Bottom Mitigation (ac)			0.0			$0
Subtotal				$3,590,800	$2,460,100	$2,460,100
Contingency		15%		$538,620	$369,015	$369,015
Subtotal Contract Cost				$4,129,420	$2,829,115	$2,829,115
		Percentage of Contract Costs				
Nourishment	0					
Geotechnical Investigations		$190,000	1	$190,000		
Secure Easements		$250,000	1	$250,000		
Environmental Monitoring		$275,079	1	$275,079		
E&D+S&A		$1,342,000	1	$1,342,000		
1st Renourishment	6					
Geotechnical Investigations		$190,000	1		$190,000	
Environmental Monitoring		$275,079	1		$275,079	
E&D+S&A		$1,342,000	1		$1,342,000	
2nd Renourishment	12					
Geotechnical Investigations		$190,000	1			$190,000
Environmental Monitoring		$275,079	1			$275,079
E&D+S&A		$1,342,000	1			$1,342,000
Total Construction Cost				$6,186,499	$4,636,194	$4,636,194

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2008	2014
Construction Cost	$6,186,499	$4,636,194	$4,636,194
Interest During Construction	$31,577	$0	$0
Total Investment Cost	$6,218,076	$4,636,194	$4,636,194
Present Worth of Each Construction	$6,218,076	$3,245,304	$2,271,690
Total Present Worth		$11,735,070	

Average Annual Cost	$1,094,006
Interest Rate	6.125%

nearshore hardbottom will be impacted by the equilibrium toe of fill. The cost of implementing the 6 year interval for the remaining 18 years of project life is shown in Table A-26. The annual cost is $1,287,000. This is the NED plan for Ft. Lauderdale. The total cost of the reevaluated Pompano Beach/Lauderdale-by-the-Sea project over a 50-year life and the (20 foot) NED plan for the Ft. Lauderdale project over an 18-year life is shown in Table A-27.

A-113. As the Pompano/LBTS reach and Ft. Lauderdale reach will be concurrently constructed, a combine cost estimate is shown in Table A-28. The annual cost to implement the Segment II NED plan for the remainder of the authorized life (18 years) is $2,228,000.

SUMMARY OF PROJECT COSTS

A-114. A summary of the project costs for the development and implementation of the Segment II project is provided in Table A-29.

ECONOMIC UPDATE OF PROJECT COSTS

A-115. The NED plan was updated to reflect a change in the interest rate (5.875 percent) and the cost of nearshore hardbottom mitigation. Table A-30 shows the annual cost of the NED plan to be $4,449,000.

TABLE A-26

Estimate of Contract and Construction Costs
Ft. Lauderdale
20' Added Shoreline Width (ft)
6 Year Renourishment Interval
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2008	2014
Nourishment	0					
Mobilization/Demobilization		$100,000	1	$100,000		
Beach Fill		$9.00	737,000	$6,633,000		
Beach Tilling (ac)		$300	69.0	$20,700		
Hard Bottom Mitigation (ac)		$300,000	3.0	$900,000		
1st Renourishment	6					
Mobilization/Demobilization		$100,000	1		$100,000	
Beach Fill		$9.00	257,000		$2,313,000	
Beach Tilling (ac)		$300	24.0		$7,200	
Hard Bottom Mitigation (ac)			0.0		$0	
2nd Renourishment	12					
Mobilization/Demobilization		$100,000	1			$100,000
Beach Fill		$9.00	257,000			$2,313,000
Beach Tilling (ac)		$300	24.0			$7,200
Hard Bottom Mitigation (ac)			0.0			$0
Subtotal				$7,653,700	$2,420,200	$2,420,200
Contingency		15%		$1,148,055	$363,030	$363,030
Subtotal Contract Cost				$8,801,755	$2,783,230	$2,783,230
		Percentage of Contract Costs				
Nourishment	0					
E&D+S&A		10%		$880,176		
1st Renourishment	6					
E&D+S&A		20%			$556,646	
2nd Renourishment	12					
E&D+S&A		20%				$556,646
Total Construction Cost				$9,681,931	$3,339,876	$3,339,876

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2008	2014
Construction Cost	$9,681,931	$3,339,876	$3,339,876
Interest During Construction	$148,255	$0	$0
Total Investment Cost	$9,830,185	$3,339,876	$3,339,876
Present Worth of Each Construction	$9,830,185	$2,337,890	$1,636,507
Total Present Worth		$13,804,582	

Average Annual Cost	$1,286,937
Interest Rate	6.125%

TABLE A-27

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea and Ft. Lauderdale
100'/20' Added Shoreline Width (ft)
5/6 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 1970	1975	1980	1985	1990	1995	2000	2002	2005	2008	2010	2014	2015
Nourishment	0															
Mobilization/Demobilization		$1,000,000	1	$1,000,000												
Beach Fill		$8.50	3,411,810	$22,176,765												
Beach Tilling (ac)		$300	84.7	$25,422												
Hard Bottom Mitigation (ac)		$300,000	12.2	$3,660,000												
1st Renourishment	5															
Mobilization/Demobilization		$1,000,000	1		$1,000,000											
Beach Fill		$8.50	935,400		$6,080,100											
Beach Tilling (ac)		$300	84.7		$25,422											
Hard Bottom Mitigation (ac)					$0											
2nd Renourishment	10															
Mobilization/Demobilization		$1,000,000	1			$1,000,000										
Beach Fill		$8.50	935,400			$6,080,100										
Beach Tilling (ac)		$300	84.7			$25,422										
Hard Bottom Mitigation (ac)						$0										
3rd Renourishment	15															
Mobilization/Demobilization		$1,000,000	1				$1,000,000									
Beach Fill		$8.50	935,400				$6,080,100									
Beach Tilling (ac)		$300	84.7				$25,422									
Hard Bottom Mitigation (ac)							$0									
4th Renourishment	20															
Mobilization/Demobilization		$1,000,000	1					$1,000,000								
Beach Fill		$8.50	935,400					$6,080,100								
Beach Tilling (ac)		$300	84.7					$25,422								
Hard Bottom Mitigation (ac)								$0								
5th Renourishment	25															
Mobilization/Demobilization		$1,000,000	1						$1,000,000							
Beach Fill		$8.50	935,400						$6,080,100							
Beach Tilling (ac)		$300	84.7						$25,422							
Hard Bottom Mitigation (ac)									$0							
6th Renourishment	30															
Mobilization/Demobilization		$1,000,000	1							$1,000,000						
Beach Fill		$8.50	935,400							$7,950,900						
Beach Tilling (ac)		$300	84.7							$25,422						
Hard Bottom Mitigation (ac)										$0						
7th Renourishment	35															
Mobilization/Demobilization		$1,000,000	1									$1,000,000				
Beach Fill		$8.50	935,400									$7,950,900				
Beach Tilling (ac)		$300	84.7									$25,422				
Hard Bottom Mitigation (ac)												$0				
8th Renourishment	40															
Mobilization/Demobilization		$1,000,000	1											$1,000,000		
Beach Fill		$8.50	935,400											$7,950,900		
Beach Tilling (ac)		$300	84.7											$25,422		
Hard Bottom Mitigation (ac)														$0		
9th Renourishment	45															
Mobilization/Demobilization		$1,000,000	1													$1,000,000
Beach Fill		$8.50	935,400													$7,950,900
Beach Tilling (ac)		$300	84.7													$25,422
Hard Bottom Mitigation (ac)																$0
Addition of Ft Lauderdale	32															
Mobilization/Demobilization		$1,000,000	1								$1,000,000					
Beach Fill		$9.00	737,000								$8,633,000					
Beach Tilling (ac)		$300	68.0								$20,700					
Hard Bottom Mitigation (ac)		$300,000	3.0								$900,000					
1st Renourishment of Fort Lauderdale	38															
Mobilization/Demobilization		$1,000,000	1										$1,000,000			
Beach Fill		$9.00	257,000										$2,313,000			
Beach Tilling (ac)		$300	24.0										$7,200			
Hard Bottom Mitigation (ac)													$0			
2nd Renourishment of Fort Lauderdale	44															
Mobilization/Demobilization		$1,000,000	1												$1,000,000	
Beach Fill		$9.00	257,000												$2,313,000	
Beach Tilling (ac)		$300	24.0												$7,200	
Hard Bottom Mitigation (ac)															$0	
Subtotal				$26,862,187	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$8,976,322	$8,553,700	$8,976,322	$3,320,200	$8,976,322	$3,320,200	$8,976,322
Contingency		15%		$4,029,328	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,346,448	$1,283,055	$1,346,448	$498,030	$1,346,448	$498,030	$1,346,448
Subtotal Contract Cost				$30,891,515	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$10,322,771	$9,836,755	$10,322,771	$3,818,230	$10,322,771	$3,818,230	$10,322,771
		Percentage of Contract Costs														
Nourishment	0															
E&D+S&A		10%	1	$3,089,152												
1st Renourishment	5															
E&D+S&A		20%	1		$1,634,270											
2nd Renourishment	10															
E&D+S&A		20%	1			$1,634,270										
3rd Renourishment	15															
E&D+S&A		20%	1				$1,634,270									
4th Renourishment	20															
E&D+S&A		20%	1					$1,634,270								
5th Renourishment	25															
E&D+S&A		20%	1						$1,634,270							
6th Renourishment	30															
E&D+S&A		20%	1							$2,064,554						
7th Renourishment	35															
E&D+S&A		20%	1									$2,064,554				
8th Renourishment	40															
E&D+S&A		20%	1											$2,064,554		
9th Renourishment	45															
E&D+S&A		20%	1													2,064,554
Addition of Ft Lauderdale	32															
E&D+S&A		10%	1								$983,676					
1st Renourishment of Fort Lauderdale	38															
E&D+S&A		20%	1										$763,646			
2nd Renourishment of Fort Lauderdale	44															
E&D+S&A		20%	1												$763,646	
Total Construction Cost				$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$10,820,431	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 1970	1975	1980	1985	1990	1995	2000	2002	2005	2008	2010	2013	2015
Construction Cost	$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$10,820,431	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325
Interest During Construction	$178,208	$0	$0	$0	$0	$0	$0	$54,542	$0	$0	$0	$0	$0
Total Investment Cost	$34,158,874	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$10,874,972	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325
Present Worth of Each Construction	$34,158,874	$7,284,279	$5,411,256	$4,019,847	$2,988,215	$2,218,392	$2,081,836	$1,622,787	$1,546,528	$683,718	$1,148,866	$355,535	$853,455
Total Present Worth							$84,371,559						

Average Annual Cost	$4,155,441
Interest Rate	6.125%

TABLE A-28

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea and Ft. Lauderdale
100' /20' Added Shoreline Width
6 Year Renourishment Interval
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2008	2014
Nourishment	0					
Mobilization/Demobilization		$1,100,000	1	$1,100,000		
Beach Fill- Pompano/LBTS		$8.50	198,000	$1,683,000		
Beach Fill- Ft. Lauderdale		$9.00	737,000	$6,633,000		
Beach Tilling (ac)		$300	95.0	$28,500		
Hard Bottom Mitigation (ac)		$300,000	6.0	$1,800,000		
1st Renourishment	6					
Mobilization/Demobilization		$1,100,000	1		$1,100,000	
Beach Fill- Pompano/LBTS		$8.50	171,000		$1,453,500	
Beach Fill- Ft. Lauderdale		$9.00	257,000		$2,313,000	
Beach Tilling (ac)		$300	46.0		$13,800	
Hard Bottom Mitigation (ac)			0.0		$0	
2nd Renourishment	12					
Mobilization/Demobilization		$1,100,000	1			$1,100,000
Beach Fill- Pompano/LBTS		$8.50	171,000			$1,453,500
Beach Fill- Ft. Lauderdale		$9.00	257,000			$2,313,000
Beach Tilling (ac)		$300	46.0			$13,800
Hard Bottom Mitigation (ac)			0.0			$0
Subtotal				$11,244,500	$4,880,300	$4,880,300
Contingency		15%		$1,686,675	$732,045	$732,045
Subtotal Contract Cost				$12,931,175	$5,612,345	$5,612,345
	Percentage of Contract Costs					
Nourishment	0					
Geotechnical Investigations		$190,000	1	$190,000		
Secure Easements		$250,000	1	$250,000		
Environmental Monitoring		$275,079	1	$275,079		
E&D+S&A		$1,342,000	1	$1,342,000		
1st Renourishment	6					
Geotechnical Investigations		$190,000	1		$190,000	
Environmental Monitoring		$275,079	1		$275,079	
E&D+S&A		$1,342,000	1		$1,342,000	
2nd Renourishment	12					
Geotechnical Investigations		$190,000	1			$190,000
Environmental Monitoring		$275,079	1			$275,079
E&D+S&A		$1,342,000	1			$1,342,000
Total Construction Cost				$14,988,254	$7,419,424	$7,419,424

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2008	2014
Construction Cost	$14,988,254	$7,419,424	$7,419,424
Interest During Construction	$76,503	$0	$0
Total Investment Cost	$15,064,757	$7,419,424	$7,419,424
Present Worth of Each Construction	$15,064,757	$5,193,546	$3,635,446
Total Present Worth		$23,893,749	

Average Annual Cost	$2,227,503
Interest Rate	6.125%

TABLE A-29

SUMMARY OF PROJECT COSTS

Project	Project Limits	Nourishment Interval (yrs)	Annualized Costs	Reference Table(s)
Reevaluation of Federal Project	R26 to R53	5	$3,984,000	A-15, A-16
Implementation of the Reevaluated Federal Project	R36 to R53	10	$967,000	A-18
Modification to the Federal Project	R53 to R74	11	$1,574,000	A-20, A-21
Combined Reevaluation and Modification of the Federal Project	R26 to R74	5 / 11	$4,146,000	A-22
Implementation of the Combined Project	R36 to R74	10	$2,355,000	A-23, A-24
Modification to the Federal Project (NED Ft. Lauderdale Project)	R53 to R71	6	$1,287,000	A-26
Reevaluated and Modified Federal Project	R26 to R71	5 / 6	$4,155,000	A-27
Implementation of the NED Combined Project	R36 to R71	6	$2,228,000	A-28

TABLE A-30

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea and Ft. Lauderdale
100'/20' Added Shoreline Width (ft)
5/6 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at indicated Year 1970	1975	1980	1985	1990	1995	2000	2002	2005	2008	2010	2014	2015
Nourishment	0															
Mobilization/Demobilization		$1,000,000	1	$1,000,000												
Beach Fill		$6.50	3,411,810	$22,176,765												
Beach Tilling (ac)		$300	84.7	$25,422												
Hard Bottom Mitigation (ac)		$650,000	12.2	$7,930,000												
1st Renourishment	5															
Mobilization/Demobilization		$1,000,000	1		$1,000,000											
Beach Fill		$6.50	935,400		$6,080,100											
Beach Tilling (ac)		$300	84.7		$25,422											
Hard Bottom Mitigation (ac)					$0											
2nd Renourishment	10															
Mobilization/Demobilization		$1,000,000	1			$1,000,000										
Beach Fill		$6.50	935,400			$6,080,100										
Beach Tilling (ac)		$300	84.7			$25,422										
Hard Bottom Mitigation (ac)						$0										
3rd Renourishment	15															
Mobilization/Demobilization		$1,000,000	1				$1,000,000									
Beach Fill		$6.50	935,400				$6,080,100									
Beach Tilling (ac)		$300	84.7				$25,422									
Hard Bottom Mitigation (ac)							$0									
4th Renourishment	20															
Mobilization/Demobilization		$1,000,000	1					$1,000,000								
Beach Fill		$6.50	935,400					$6,080,100								
Beach Tilling (ac)		$300	84.7					$25,422								
Hard Bottom Mitigation (ac)								$0								
5th Renourishment	25															
Mobilization/Demobilization		$1,000,000	1						$1,000,000							
Beach Fill		$6.50	935,400						$6,080,100							
Beach Tilling (ac)		$300	84.7						$25,422							
Hard Bottom Mitigation (ac)									$0							
6th Renourishment	30															
Mobilization/Demobilization		$1,000,000	1							$1,000,000						
Beach Fill		$6.50	935,400							$7,950,900						
Beach Tilling (ac)		$300	84.7							$25,422						
Hard Bottom Mitigation (ac)										$0						
7th Renourishment	35															
Mobilization/Demobilization		$1,000,000	1									$1,000,000				
Beach Fill		$8.50	935,400									$7,950,900				
Beach Tilling (ac)		$300	84.7									$25,422				
Hard Bottom Mitigation (ac)												$0				
8th Renourishment	40															
Mobilization/Demobilization		$1,000,000	1											$1,000,000		
Beach Fill		$8.50	935,400											$7,950,900		
Beach Tilling (ac)		$300	84.7											$25,422		
Hard Bottom Mitigation (ac)														$0		
9th Renourishment	45															
Mobilization/Demobilization		$1,000,000	1													$1,000,000
Beach Fill		$6.50	935,400													$7,950,900
Beach Tilling (ac)		$300	84.7													$25,422
Hard Bottom Mitigation (ac)																$0
Addition of Ft Lauderdale	32															
Mobilization/Demobilization		$1,000,000	1								$1,000,000					
Beach Fill		$9.00	737,000								$6,633,000					
Beach Tilling (ac)		$300	69.0								$20,700					
Hard Bottom Mitigation (ac)		$650,000	3.0								$1,950,000					
1st Renourishment of Fort Lauderdale	38															
Mobilization/Demobilization		$1,000,000	1										$1,000,000			
Beach Fill		$9.00	257,000										$2,313,000			
Beach Tilling (ac)		$300	24.0										$7,200			
Hard Bottom Mitigation (ac)													$0			
2nd Renourishment of Fort Lauderdale	44															
Mobilization/Demobilization		$1,000,000	1												$1,000,000	
Beach Fill		$9.00	257,000												$2,313,000	
Beach Tilling (ac)		$300	24.0												$7,200	
Hard Bottom Mitigation (ac)															$0	
Subtotal				$31,132,187	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$8,976,322	$9,603,700	$8,976,322	$3,320,200	$8,976,322	$3,320,200	$8,976,322
Contingency		15%		$4,669,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,346,448	$1,440,555	$1,346,448	$498,030	$1,346,448	$498,030	$1,346,448
Subtotal Contract Cost				$35,802,015	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$10,322,771	$11,044,255	$10,322,771	$3,818,230	$10,322,771	$3,818,230	$10,322,771
		Percentage of Contract Costs														
Nourishment	0															
E&D+S&A		10%	1	$3,580,202												
1st Renourishment	5															
E&D+S&A		20%	1		$1,634,270											
2nd Renourishment	10															
E&D+S&A		20%	1			$1,634,270										
3rd Renourishment	15															
E&D+S&A		20%	1				$1,634,270									
4th Renourishment	20															
E&D+S&A		20%	1					$1,634,270								
5th Renourishment	25															
E&D+S&A		20%	1						$1,634,270							
6th Renourishment	30															
E&D+S&A		20%	1							$2,064,554						
7th Renourishment	35															
E&D+S&A		20%	1									$2,064,554				
8th Renourishment	40															
E&D+S&A		20%	1											$2,064,554		
9th Renourishment	45															
E&D+S&A		20%	1													2,064,554
Addition of Ft Lauderdale	32															
E&D+S&A		10%	1								$1,104,426					
1st Renourishment of Fort Lauderdale	38															
E&D+S&A		20%	1										$763,646			
2nd Renourishment of Fort Lauderdale	44															
E&D+S&A		20%	1												$763,646	
Total Construction Cost				$39,382,217	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,148,681	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 1970	1975	1980	1985	1990	1995	2000	2002	2005	2002	2010	2013	2015
Construction Cost	$39,382,217	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,148,681	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325
Interest During Construction	$197,894	$0	$0	$0	$0	$0	$0	$58,767	$0	$0	$0	$0	$0
Total Investment Cost	$39,580,110	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,207,447	$12,387,325	$4,581,876	$12,387,325	$4,581,876	$12,387,325
Present Worth of Each Construction	$39,580,110	$7,370,687	$5,540,397	$4,164,604	$3,130,449	$2,353,095	$2,234,471	$1,964,424	$1,679,607	$737,316	$1,262,527	$393,483	$949,016
Total Present Worth							$71,360,187						

Average Annual Cost	$4,448,595
Interest Rate	5.875%

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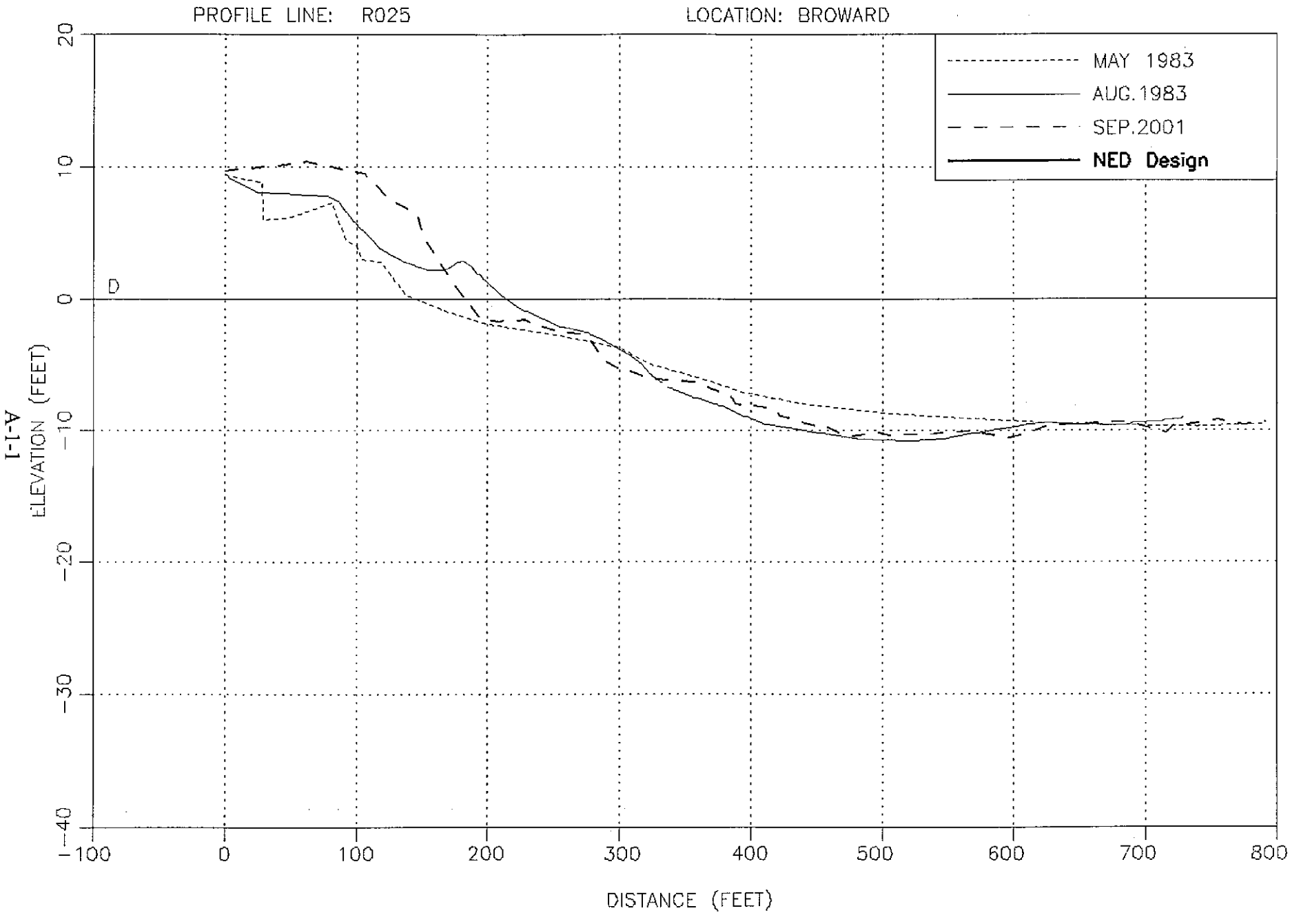
SUB-APPENDIX A-1

CROSS-SECTIONS

POMPANO BEACH/LAUDERDALE-BY-THE-SEA

TYPICAL PROJECT CROSS-SECTIONS


PROFILE LINE: R025
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
A-1-1
ELEVATION (FEET)
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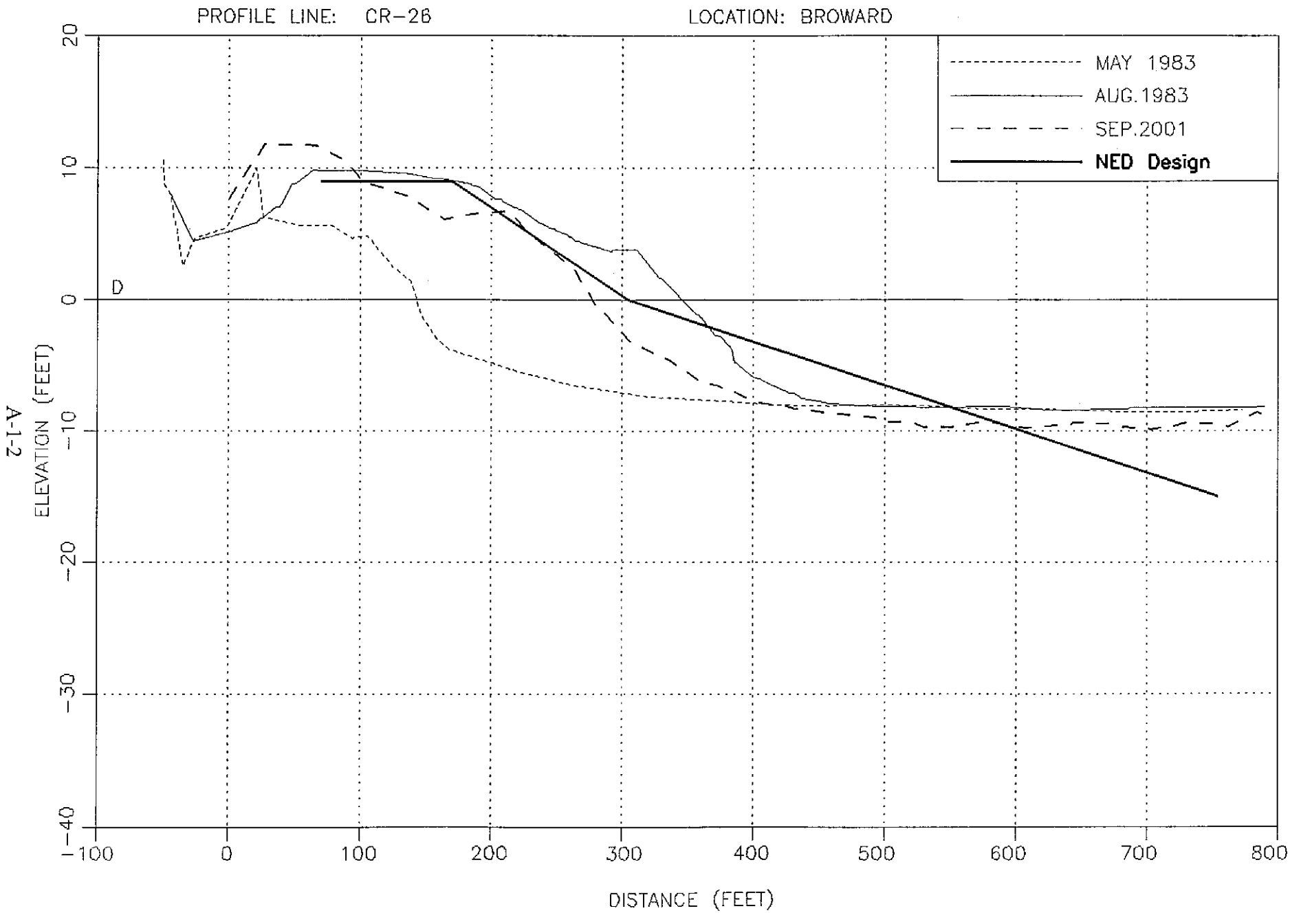
700
800
DISTANCE (FEET)


PROFILE LINE: CR-26
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
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ELEVATION (FEET)
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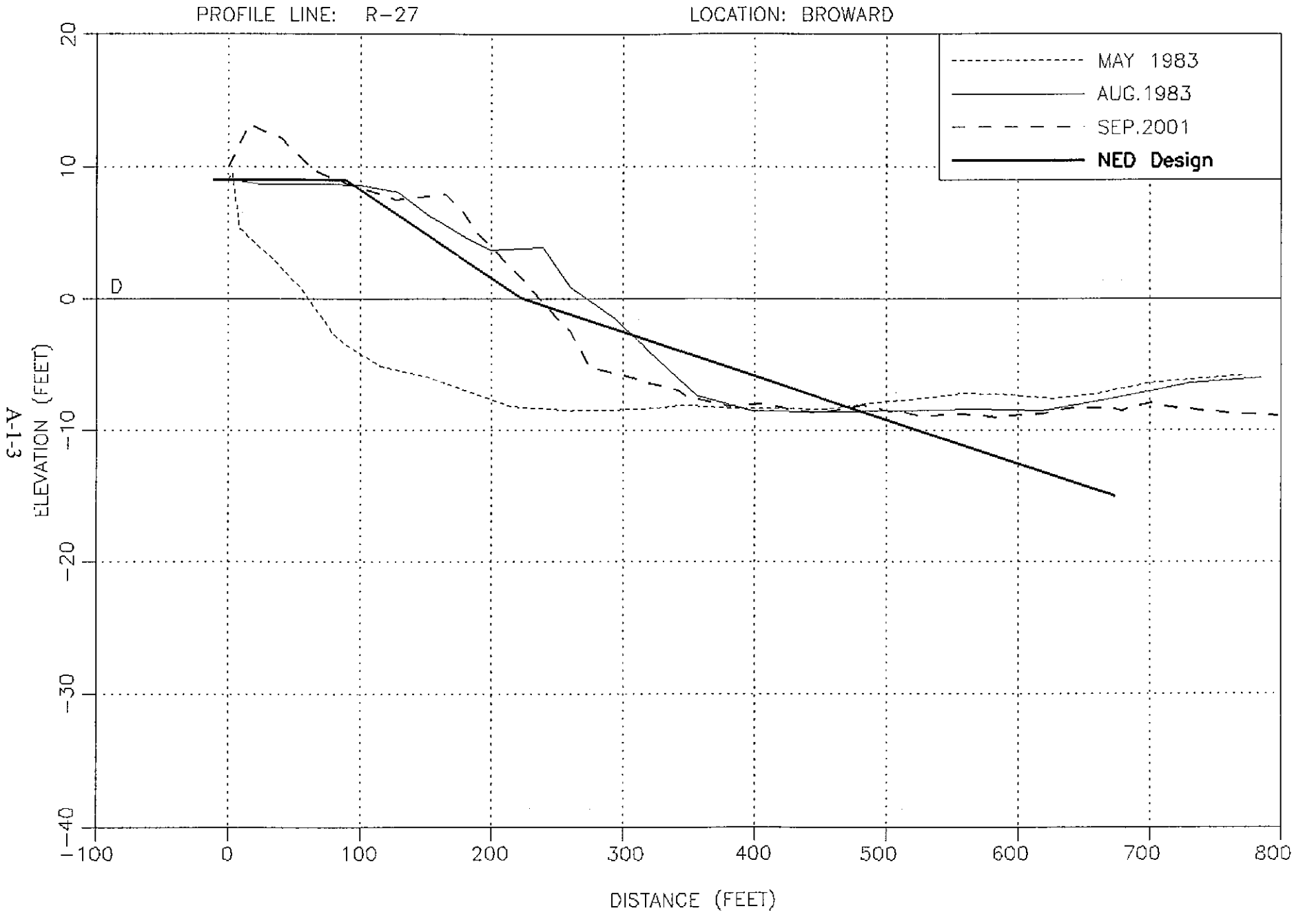
DISTANCE (FEET)


PROFILE LINE: R-27
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
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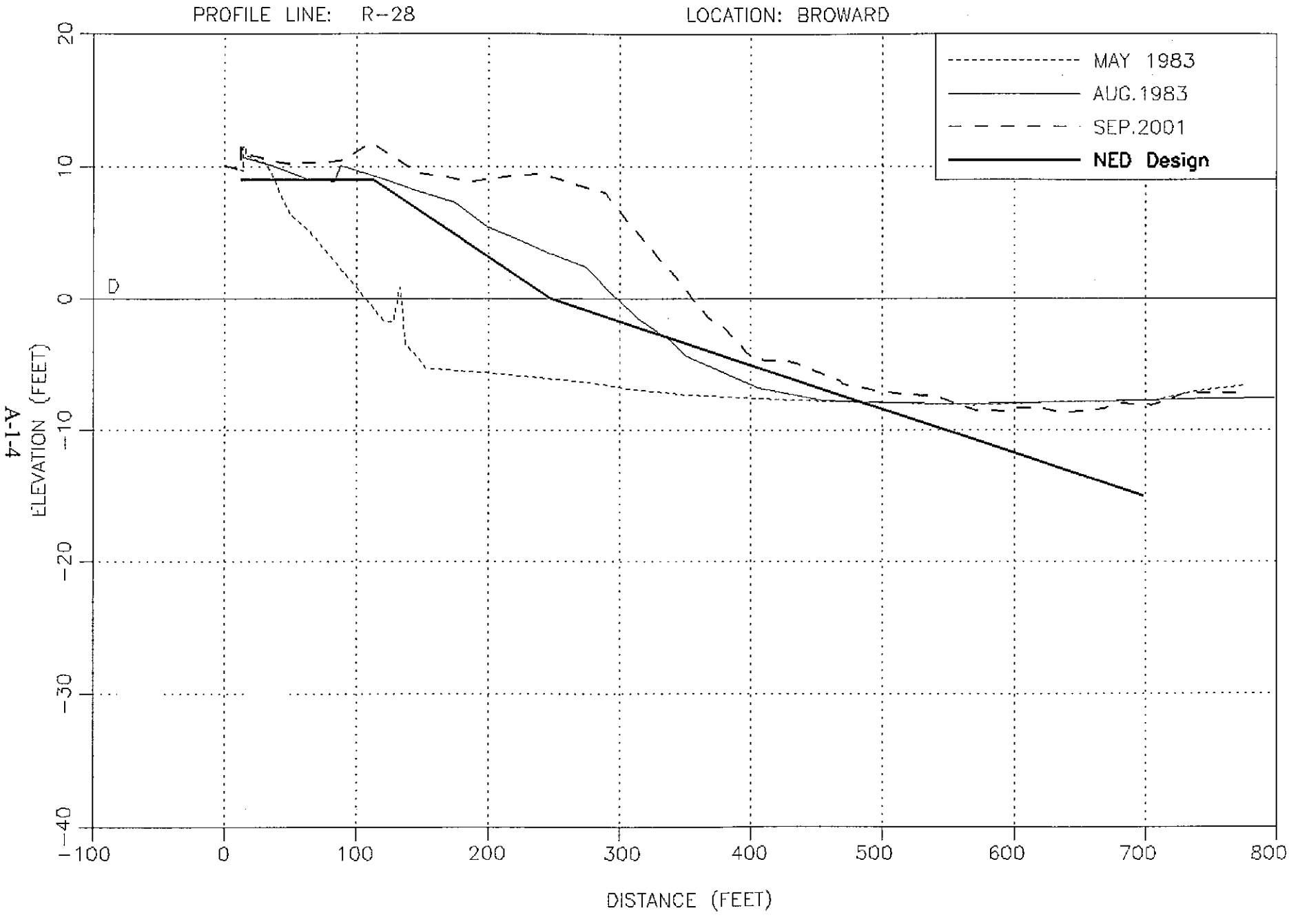
ELEVATION (FEET)
DISTANCE (FEET)
A-1-3


PROFILE LINE: R-28
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
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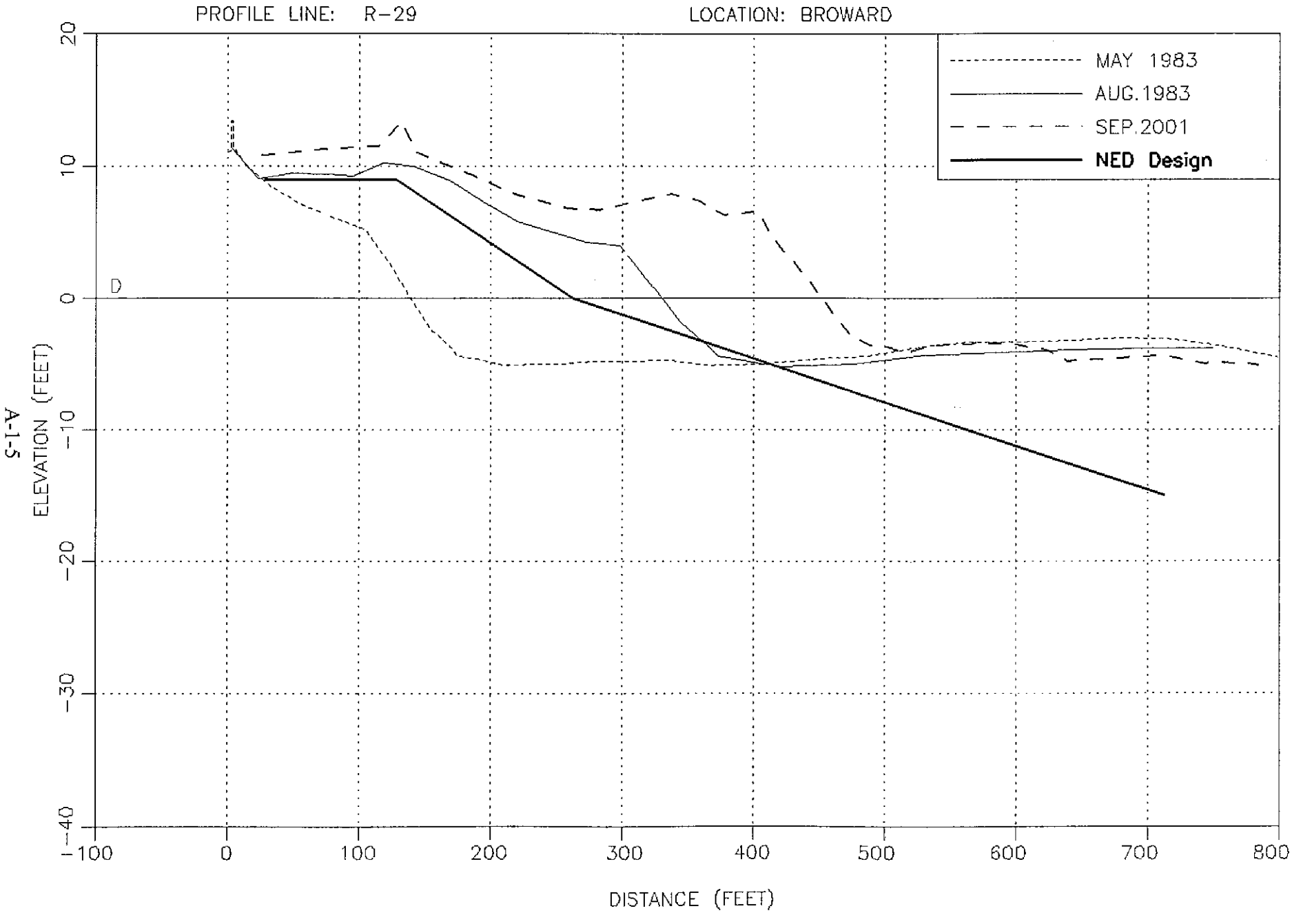
ELEVATION (FEET)
DISTANCE (FEET)

A-1-4


PROFILE LINE: R-29
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
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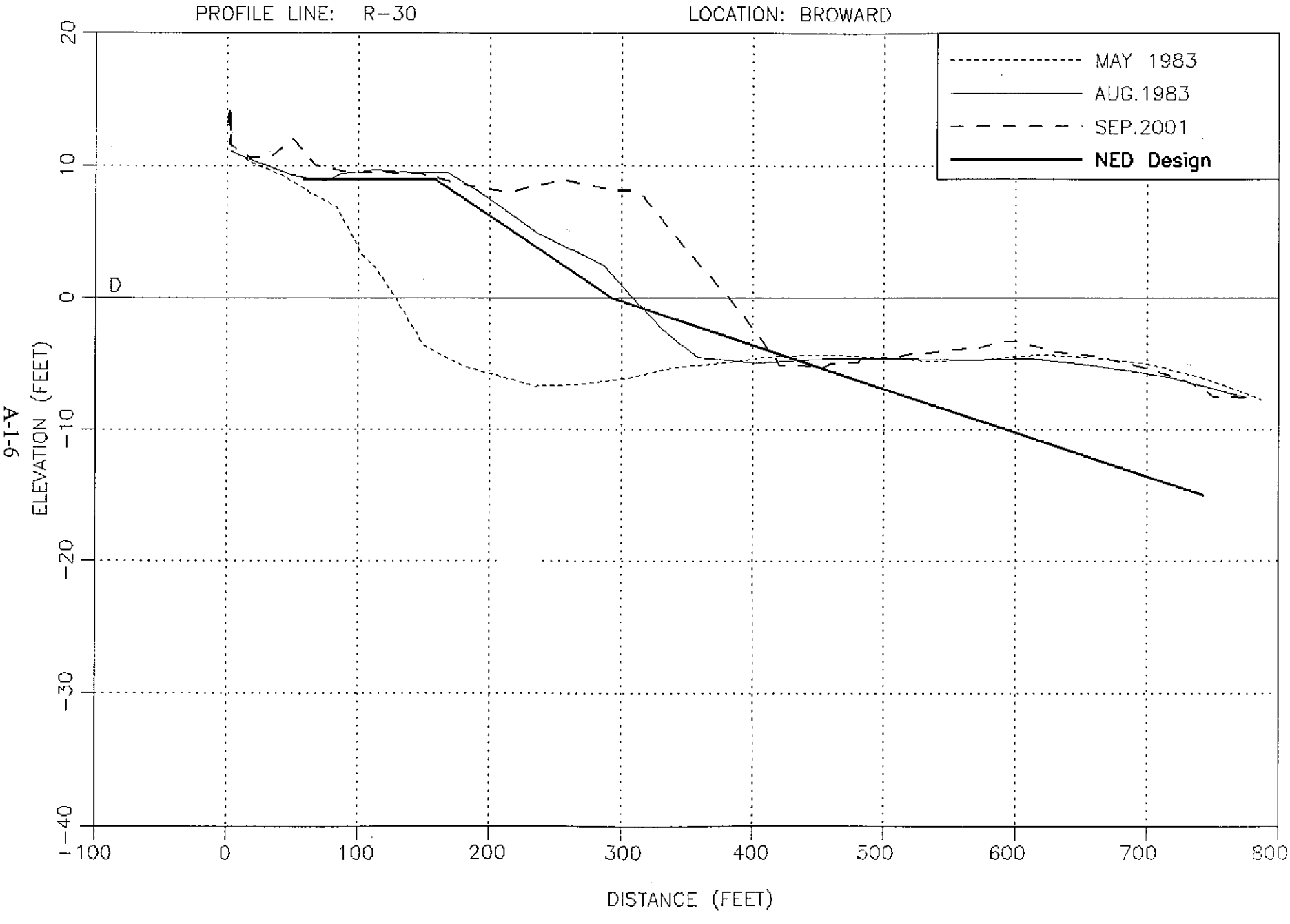
ELEVATION (FEET)
DISTANCE (FEET)

A-1-5


PROFILE LINE: R-30
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-100
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700
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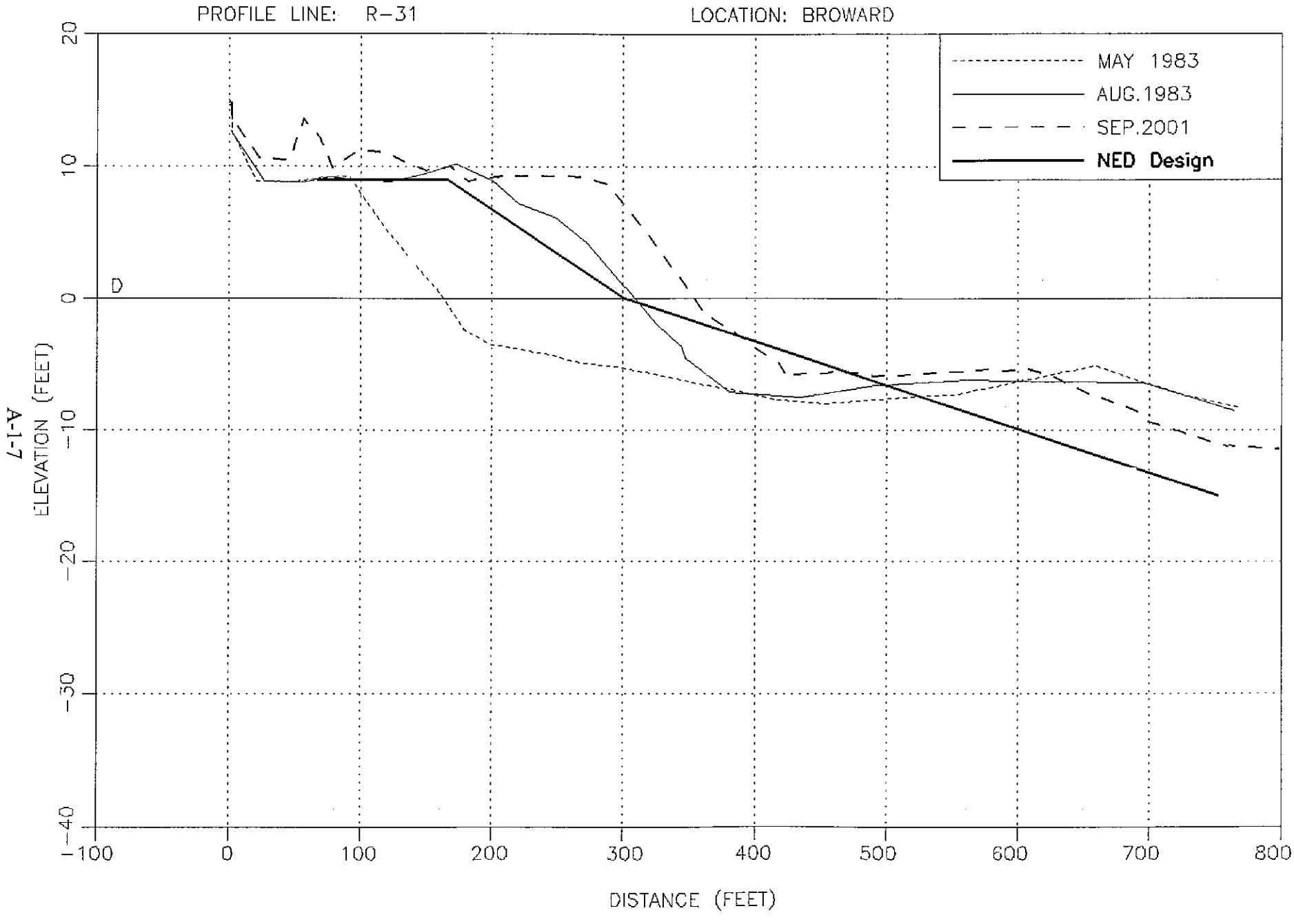
PROFILE LINE: R-31
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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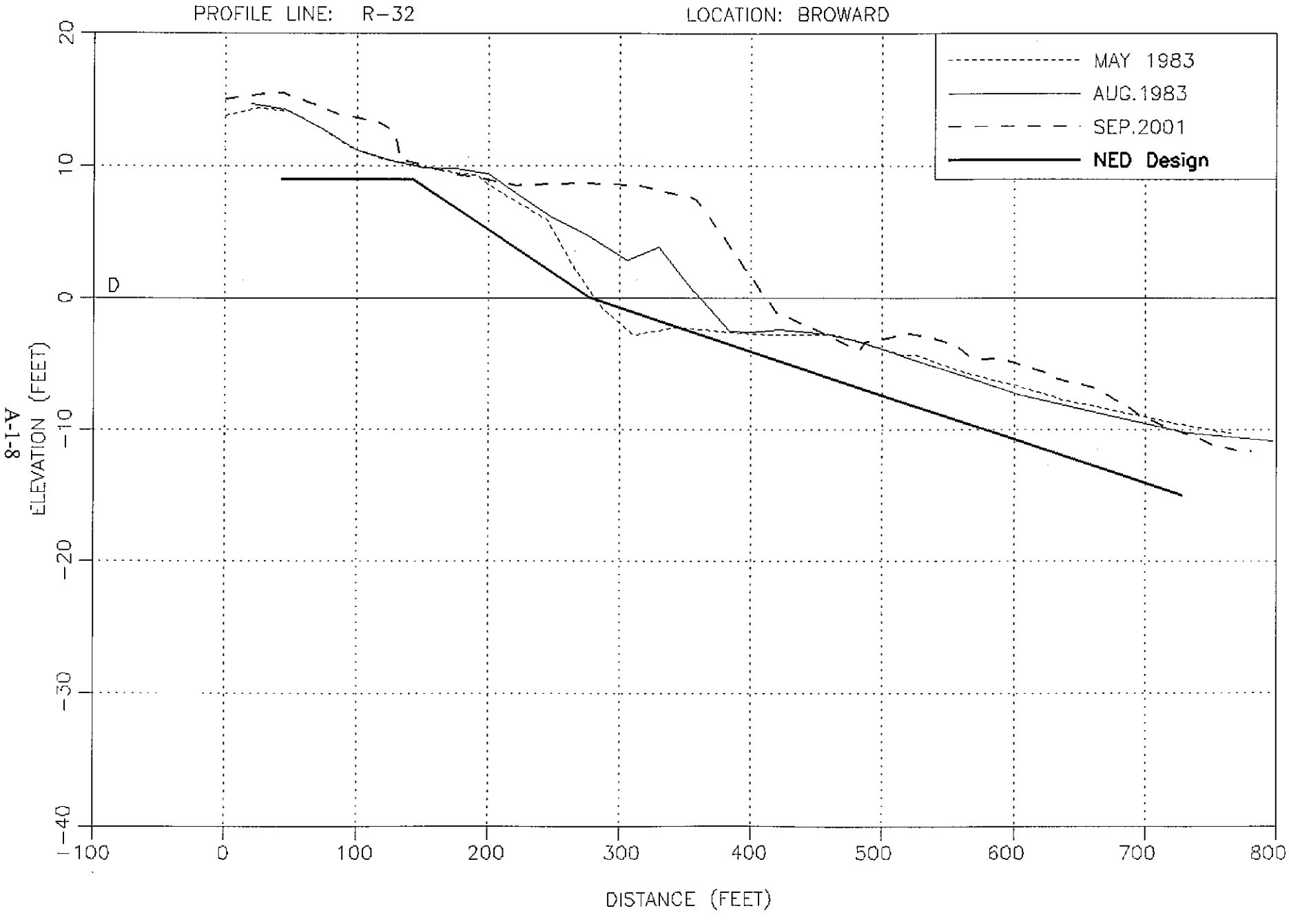
700
800


PROFILE LINE: R-32
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-100
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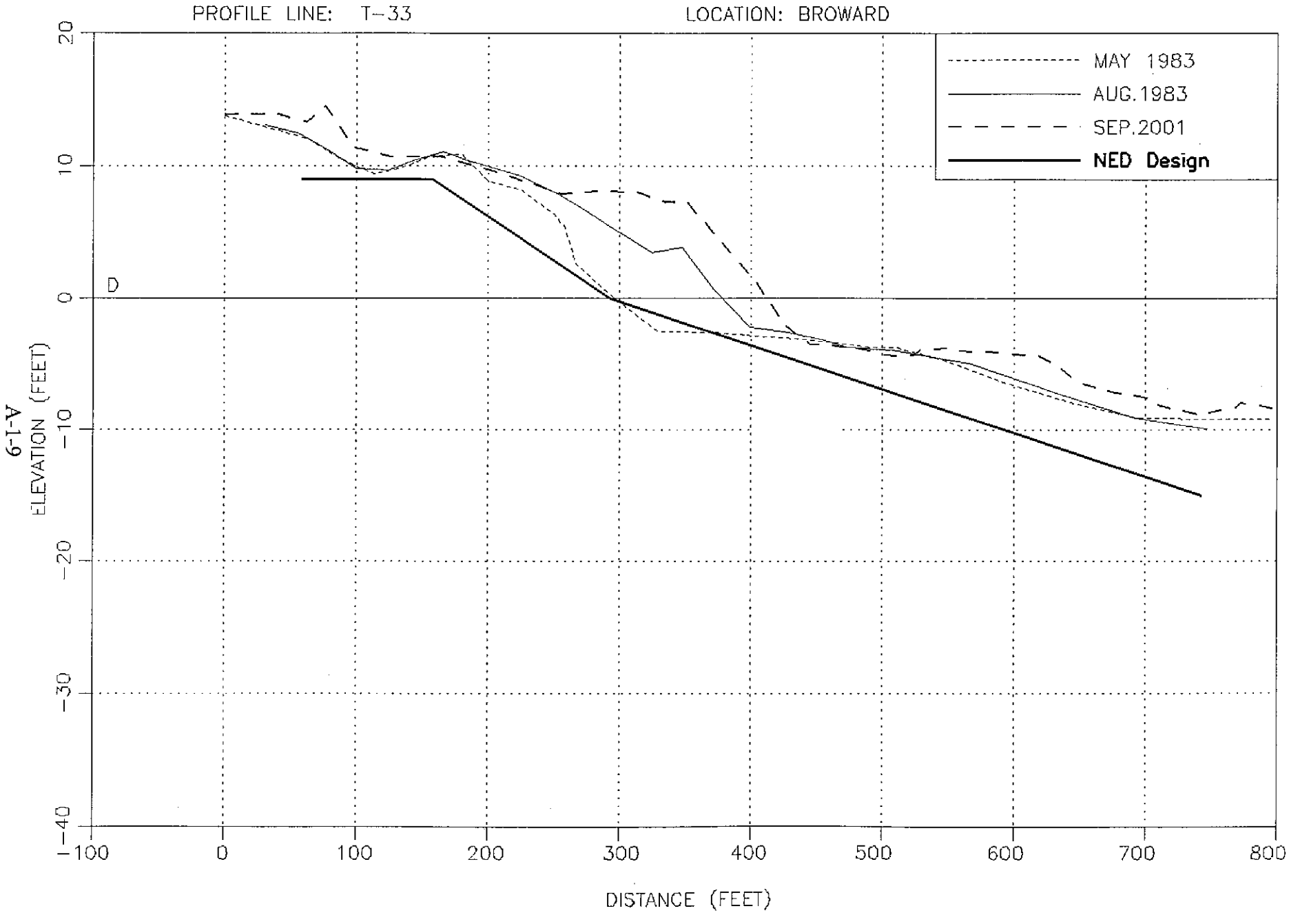
800

A-1-8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LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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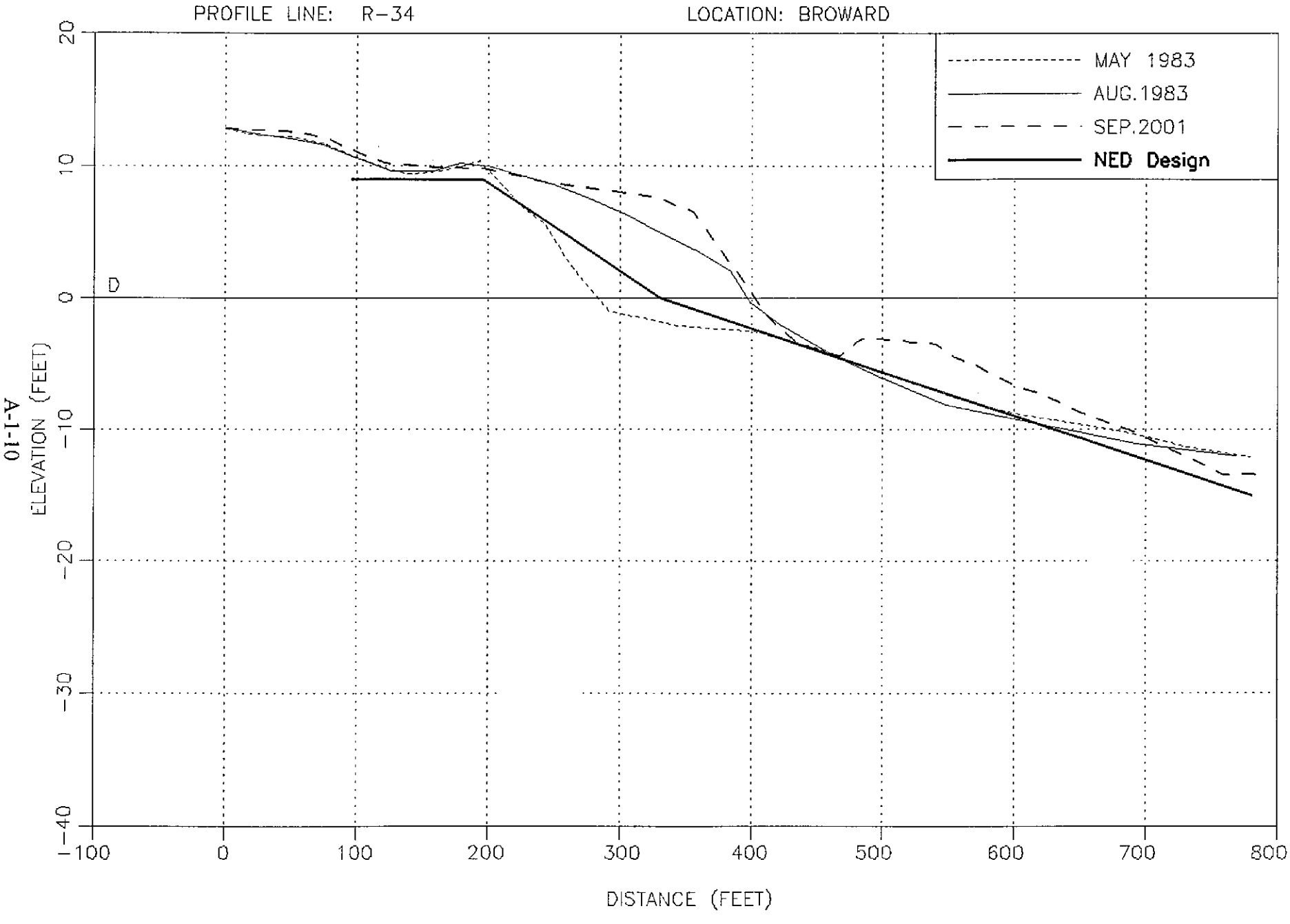
300
400
500
600
700
800

A-1-9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LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
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0
-10
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200
300
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700
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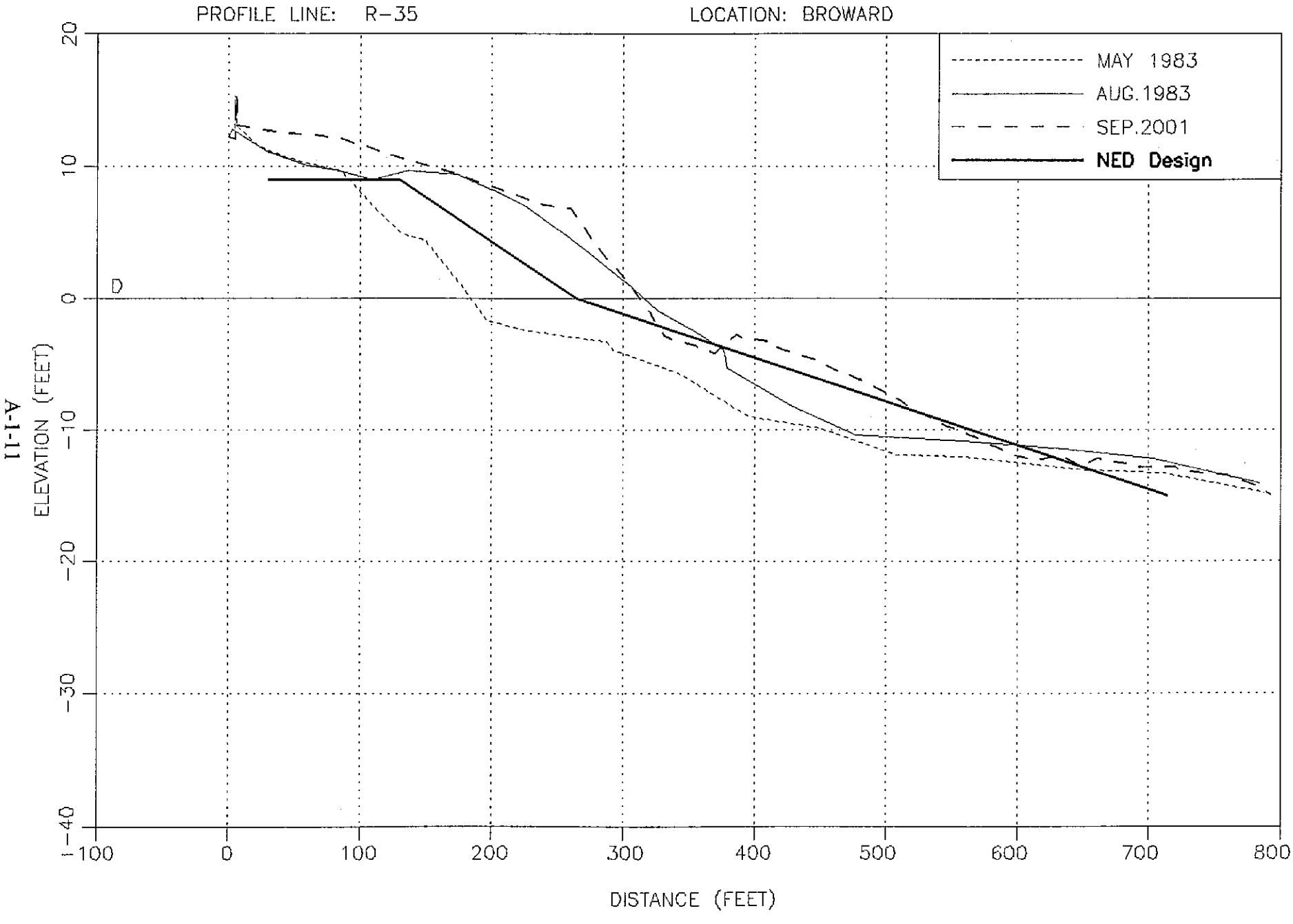
ELEVATION (FEET)
DISTANCE (FEET)


PROFILE LINE: R-35
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
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10
0
-10
-20
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200
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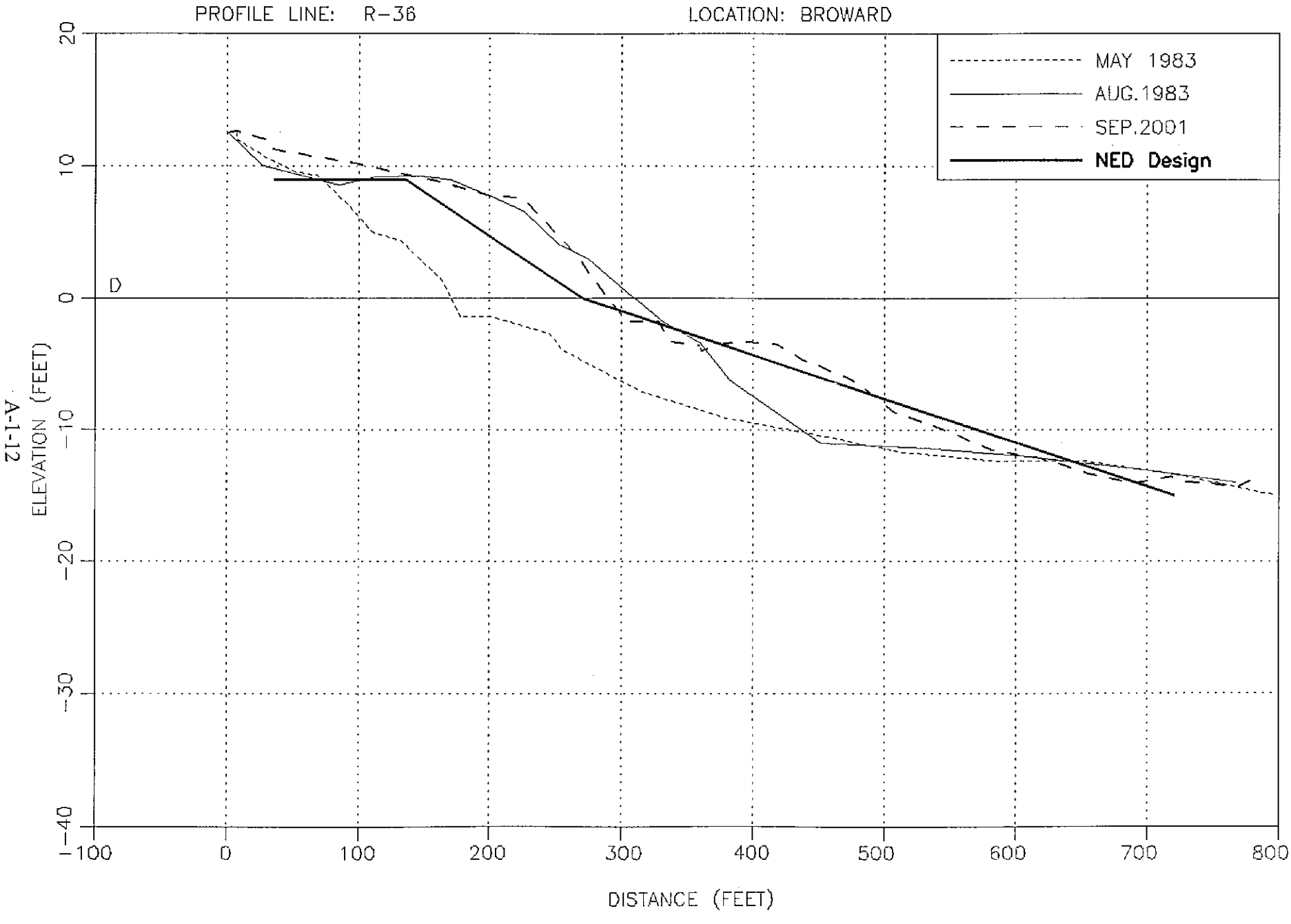
ELEVATION (FEET)
DISTANCE (FEET)

A-1-11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LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
A-1-12
ELEVATION (FEET)
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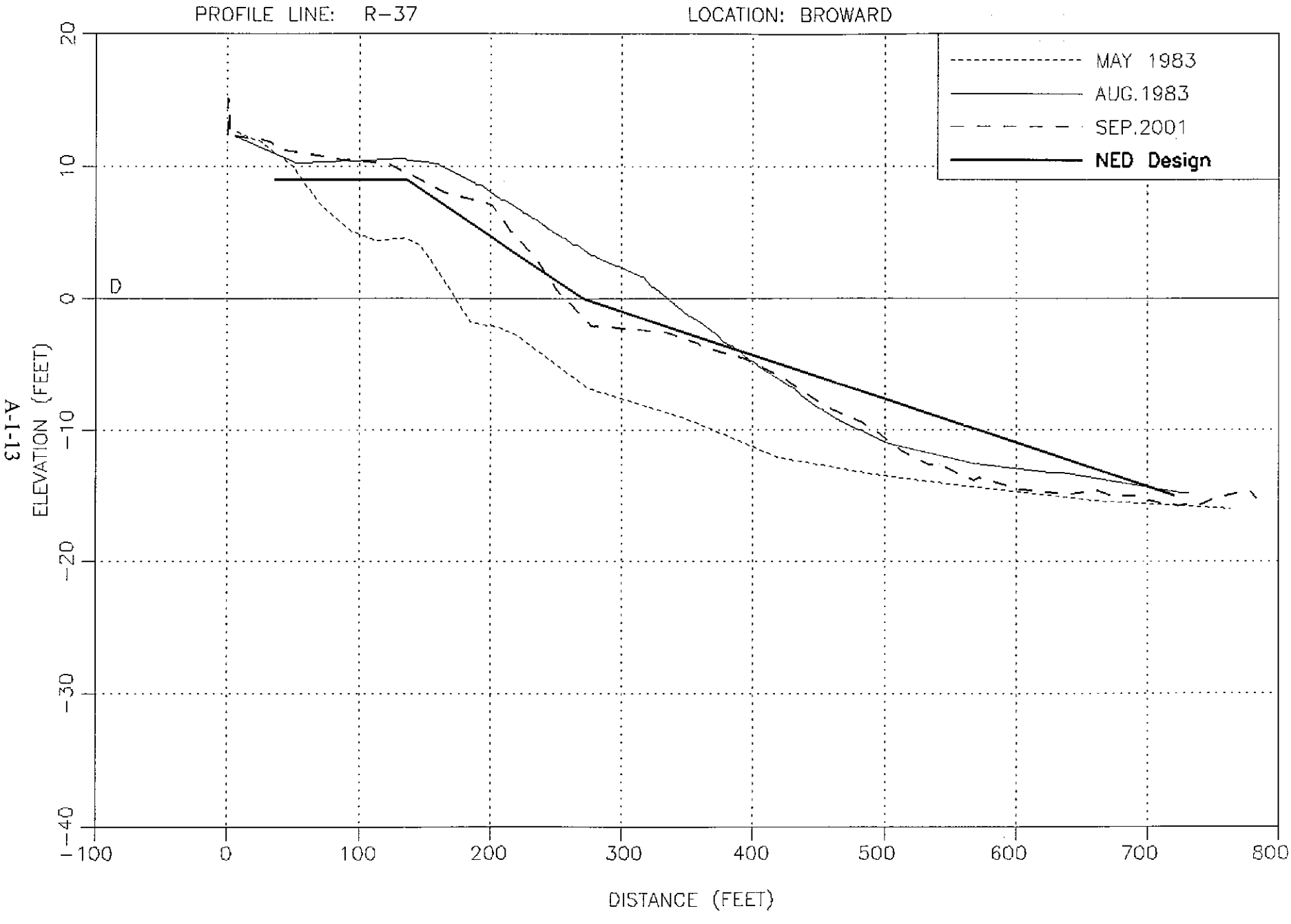
DISTANCE (FEET)


PROFILE LINE: R-37
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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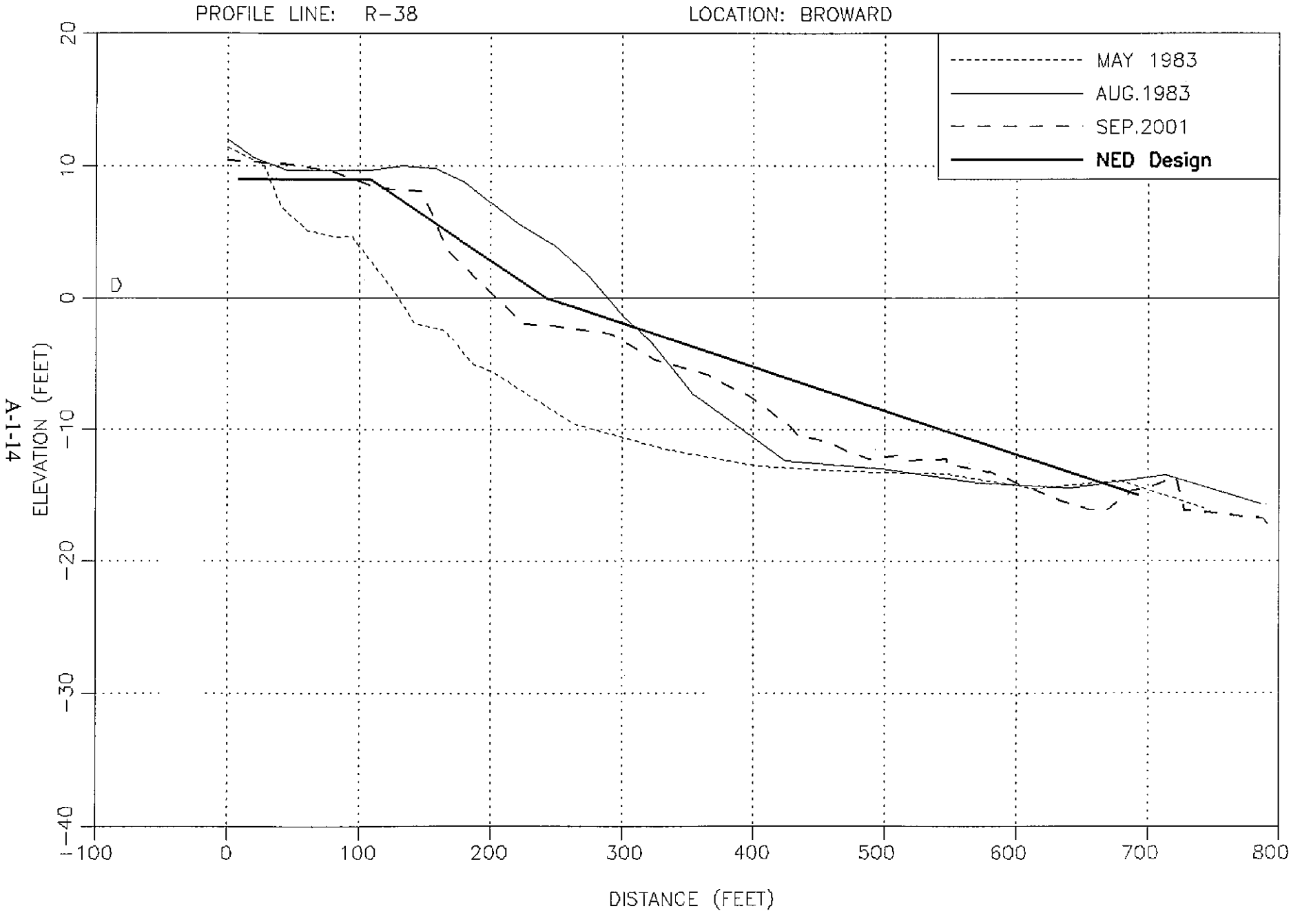
A-1-13


PROFILE LINE: R-38
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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700
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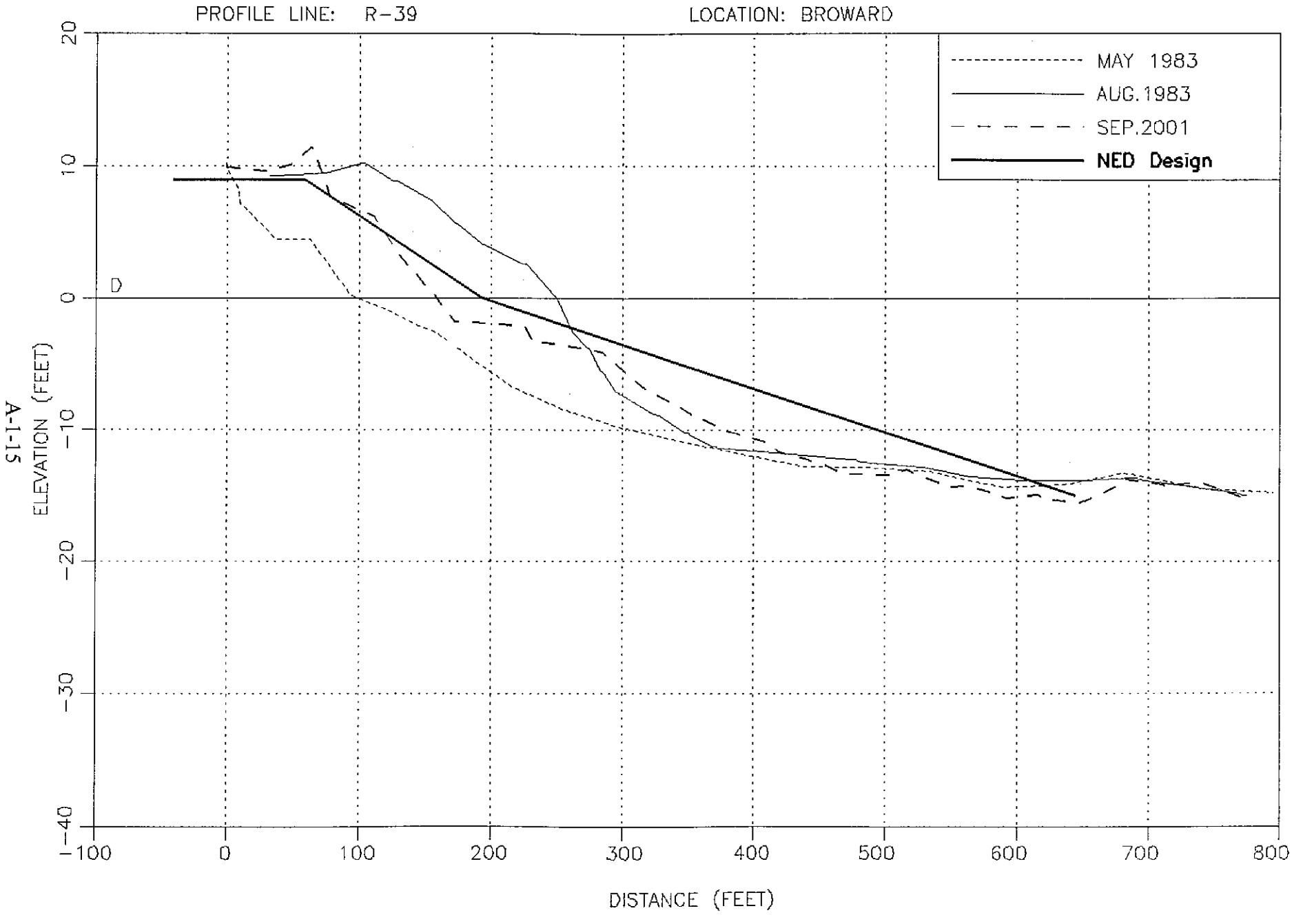
A-1-14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AUG.1983
SEP.2001
NED Design
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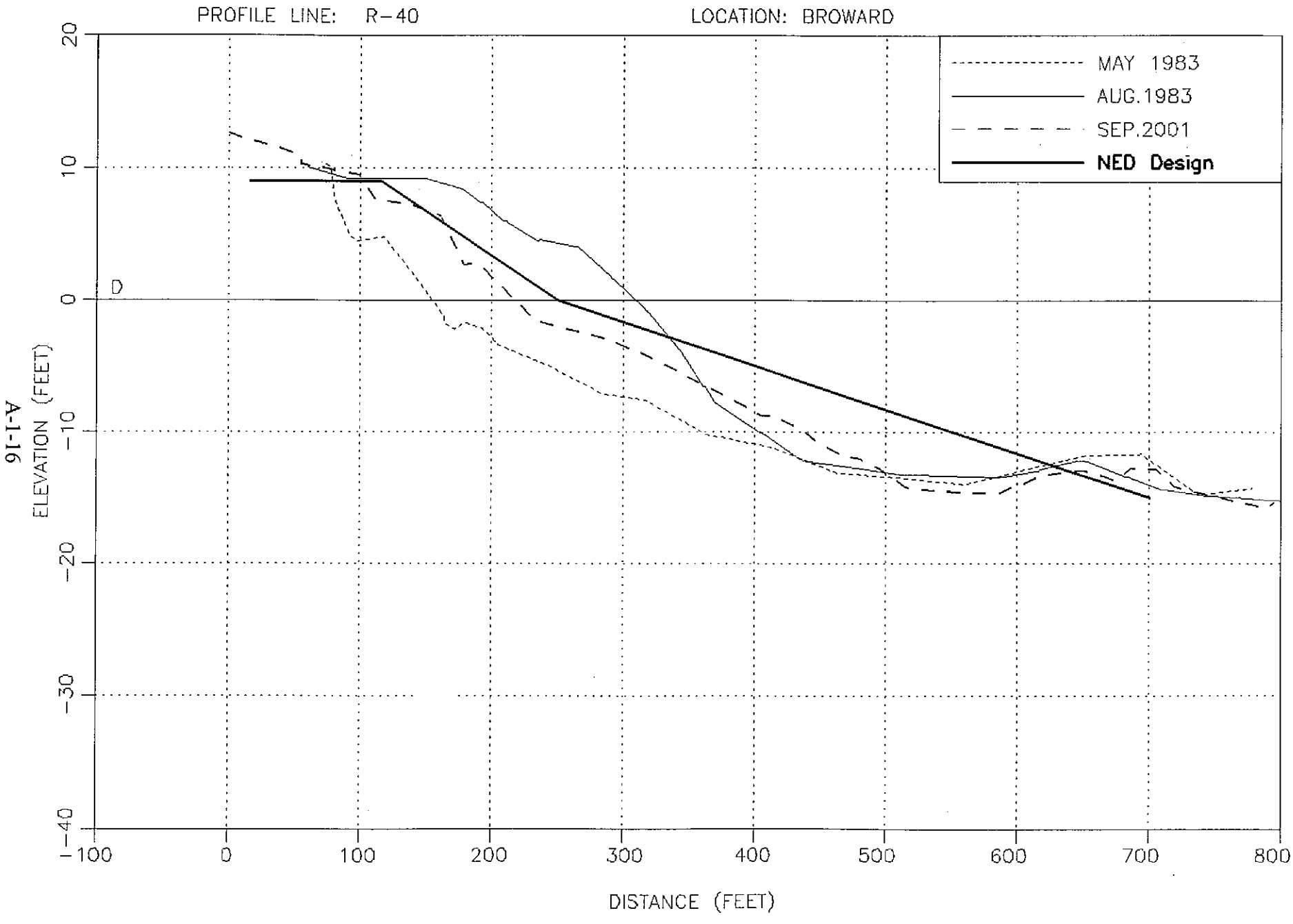
ELEVATION (FEET)
DISTANCE (FEET)

A-1-15


PROFILE LINE: R-40
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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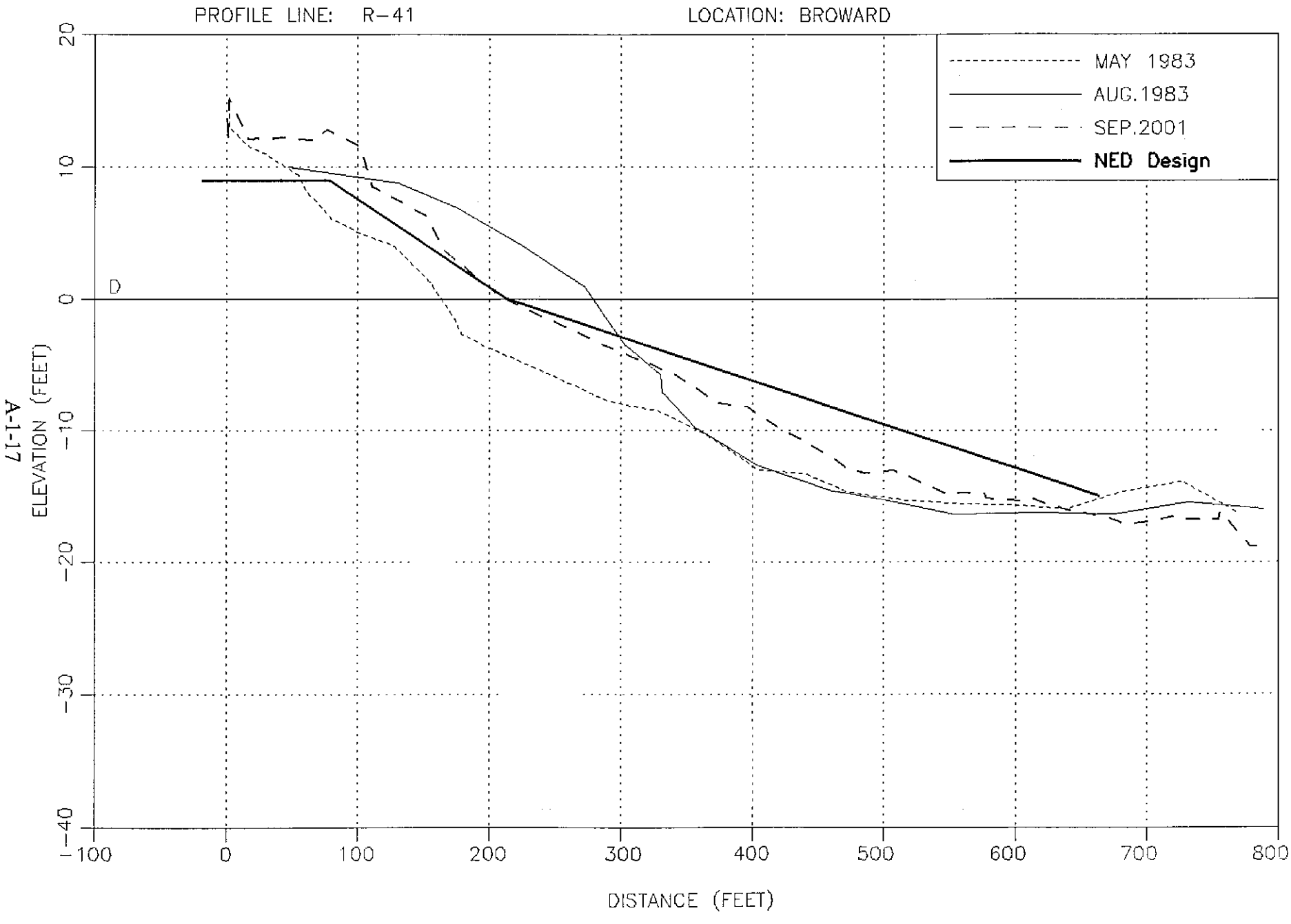
PROFILE LINE: R-41
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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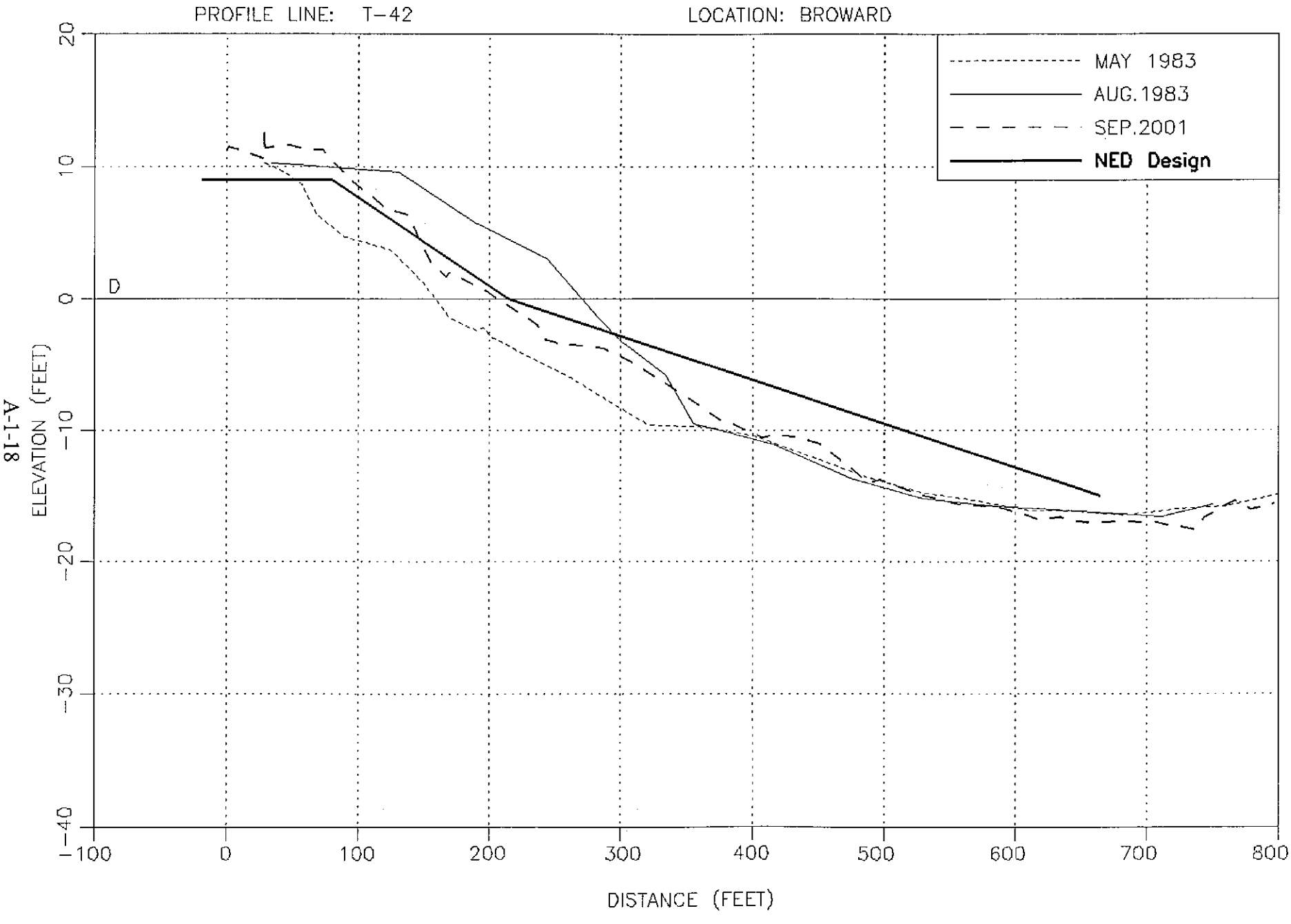
PROFILE LINE: T-42
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
L
D
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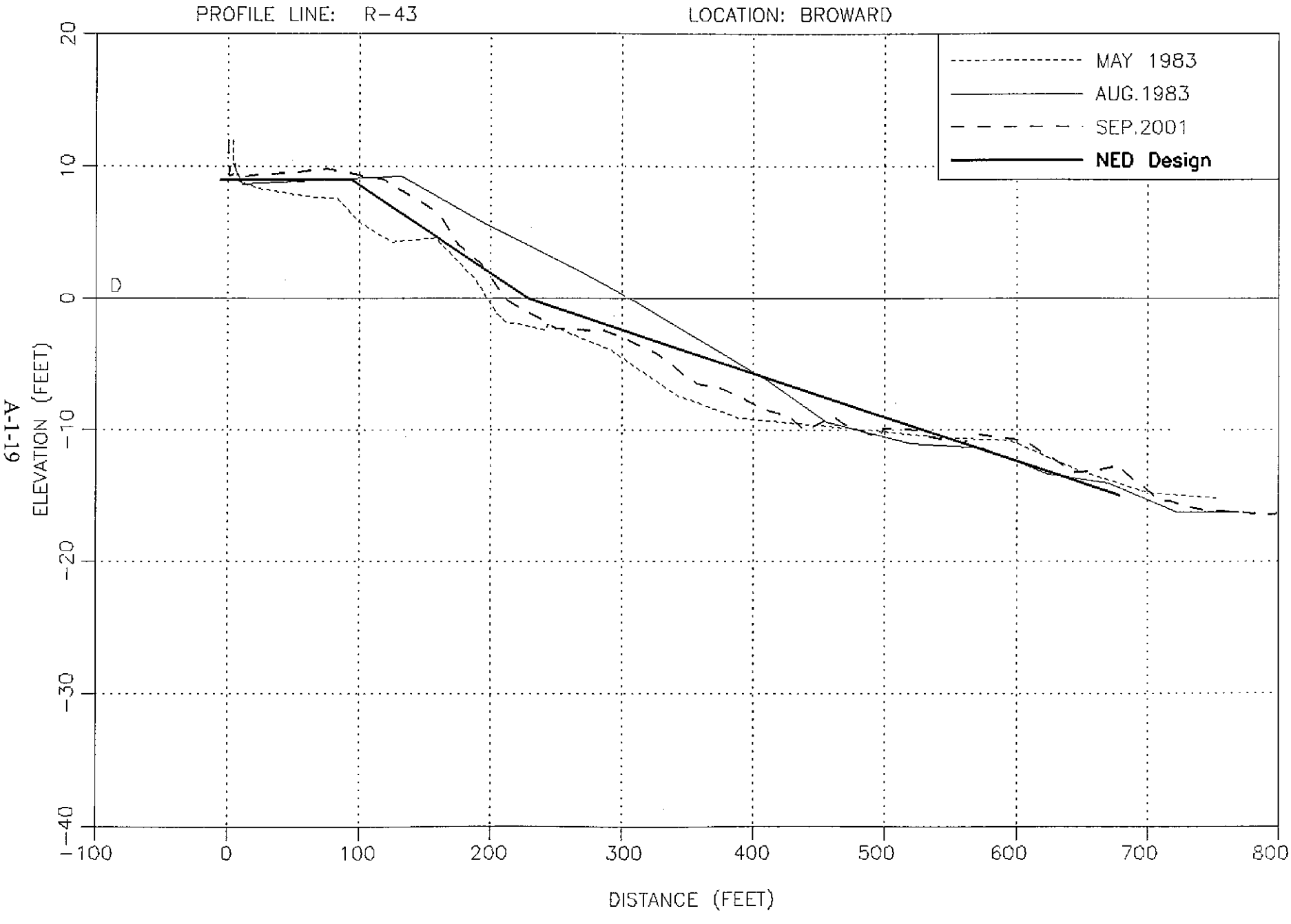
800
ELEVATION (FEET)
DISTANCE (FEET)


PROFILE LINE: R-43
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MAY 1983
AUG.1983
SEP.2001
NED Design
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ELEVATION (FEET)
DISTANCE (FEET)
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-40
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600
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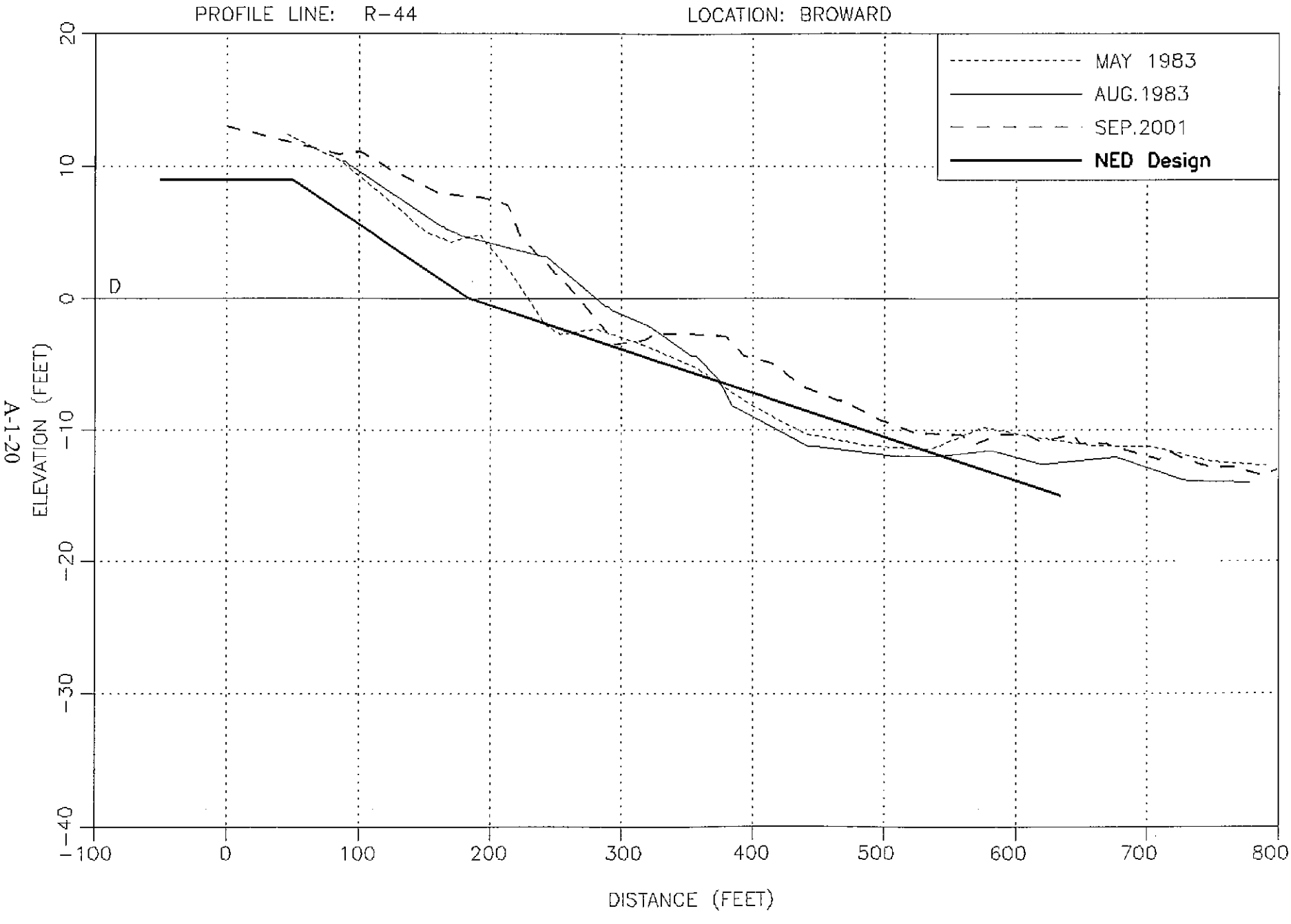
PROFILE LINE: R-44
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
A-1-20
ELEVATION (FEET)
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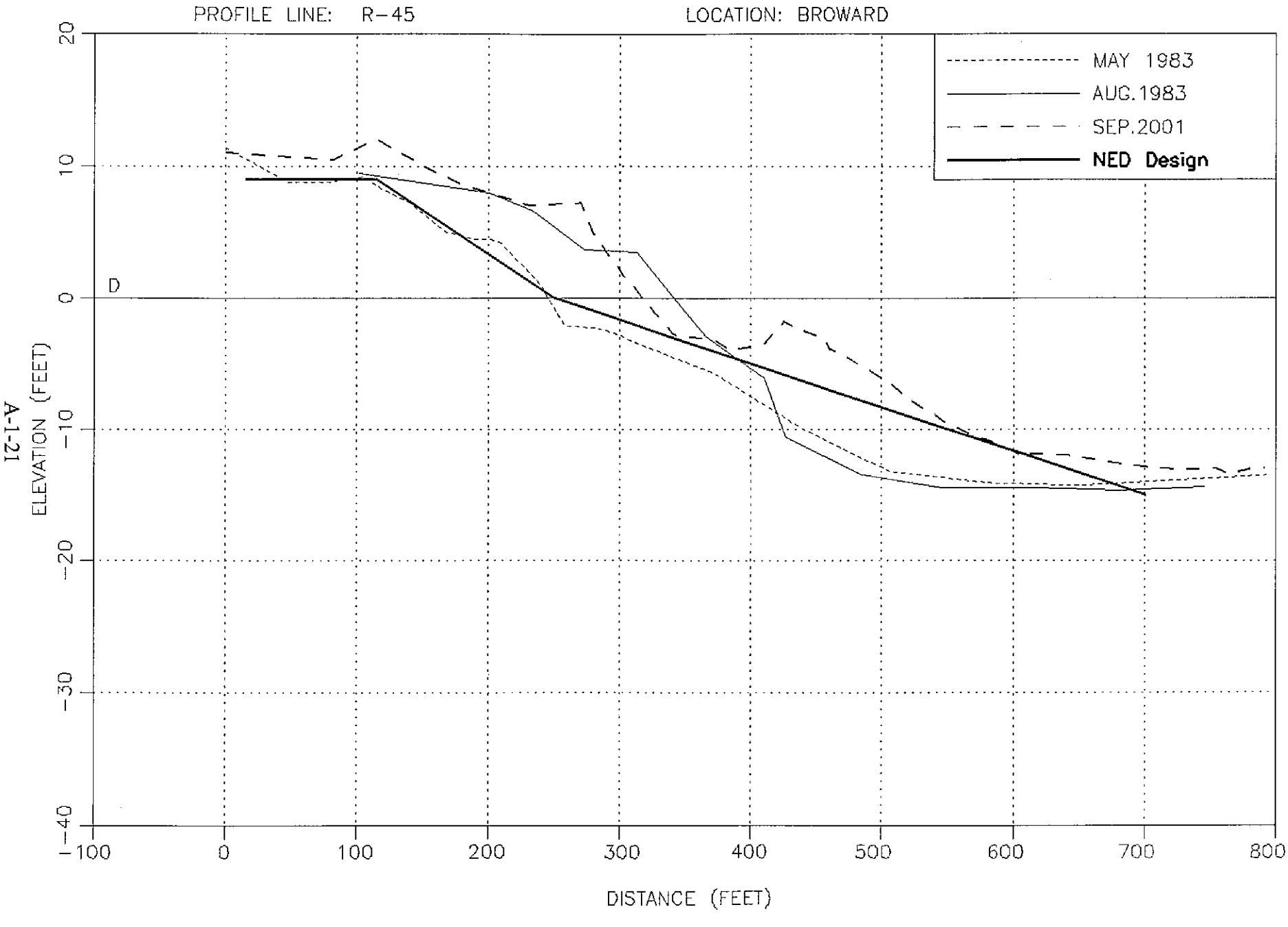
300
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R-45
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-40
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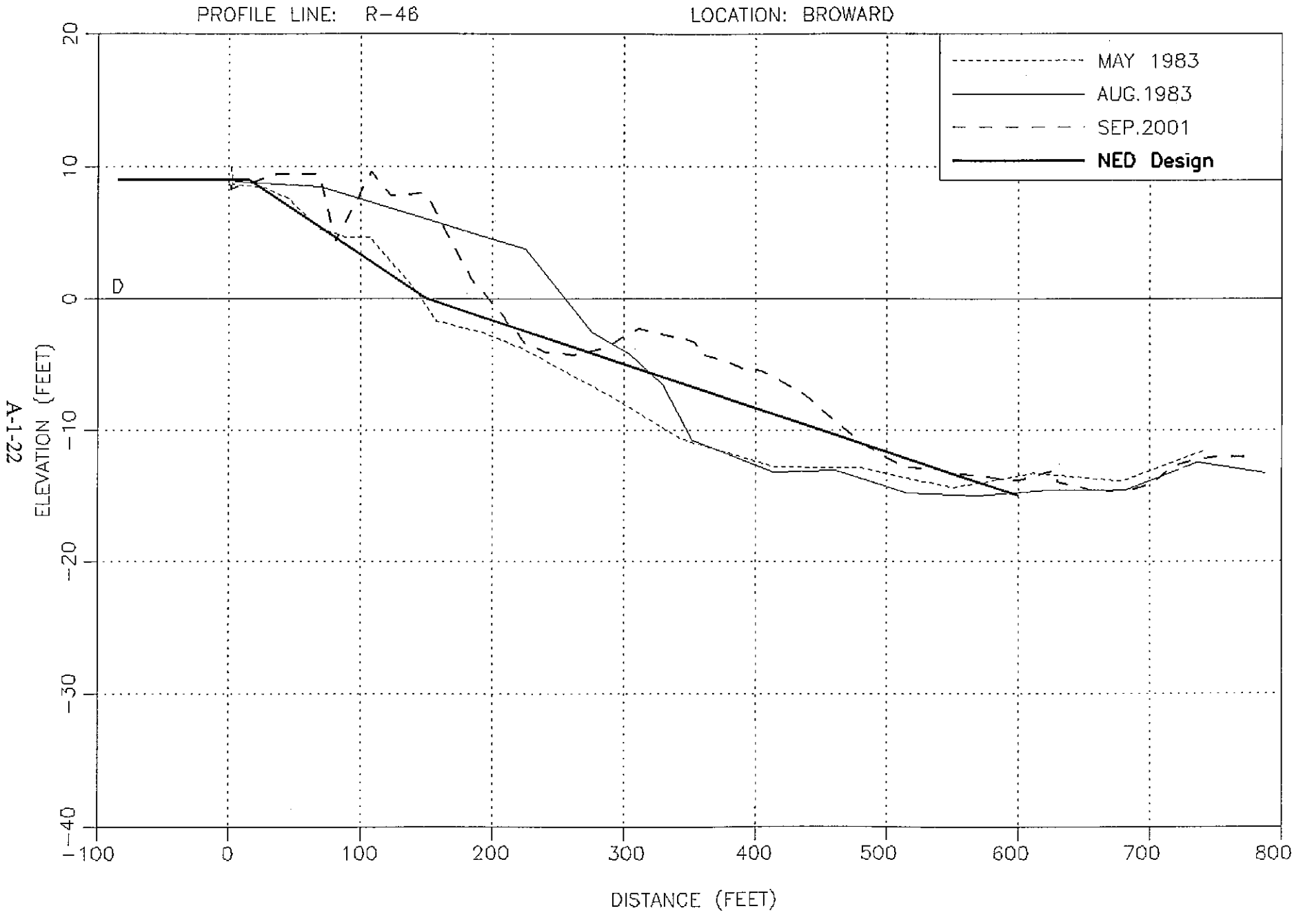
600
700
800

A-1-21


PROFILE LINE: R-46
LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-40
-100
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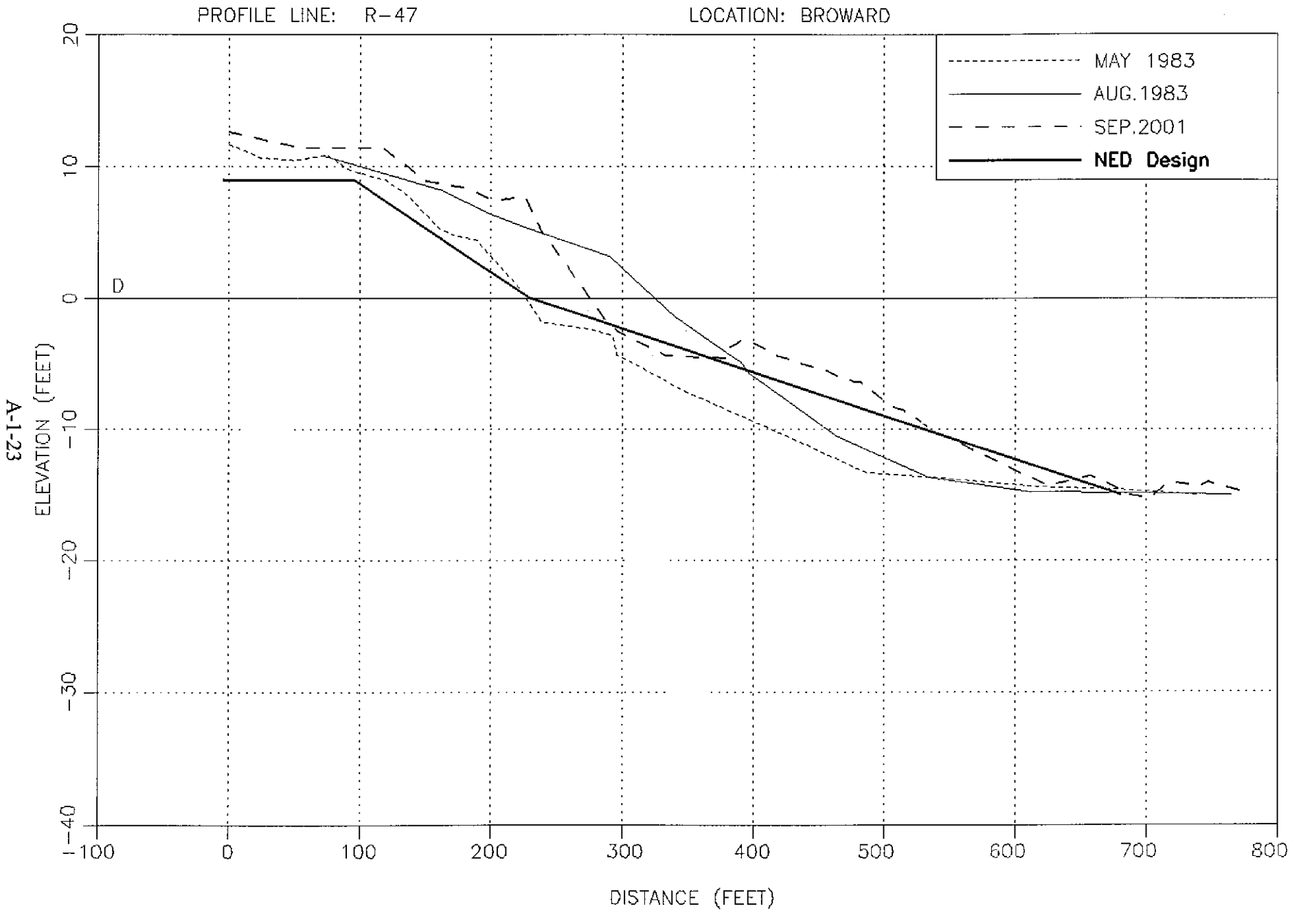
700
800


PROFILE LINE: R-47
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-30
-40
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600
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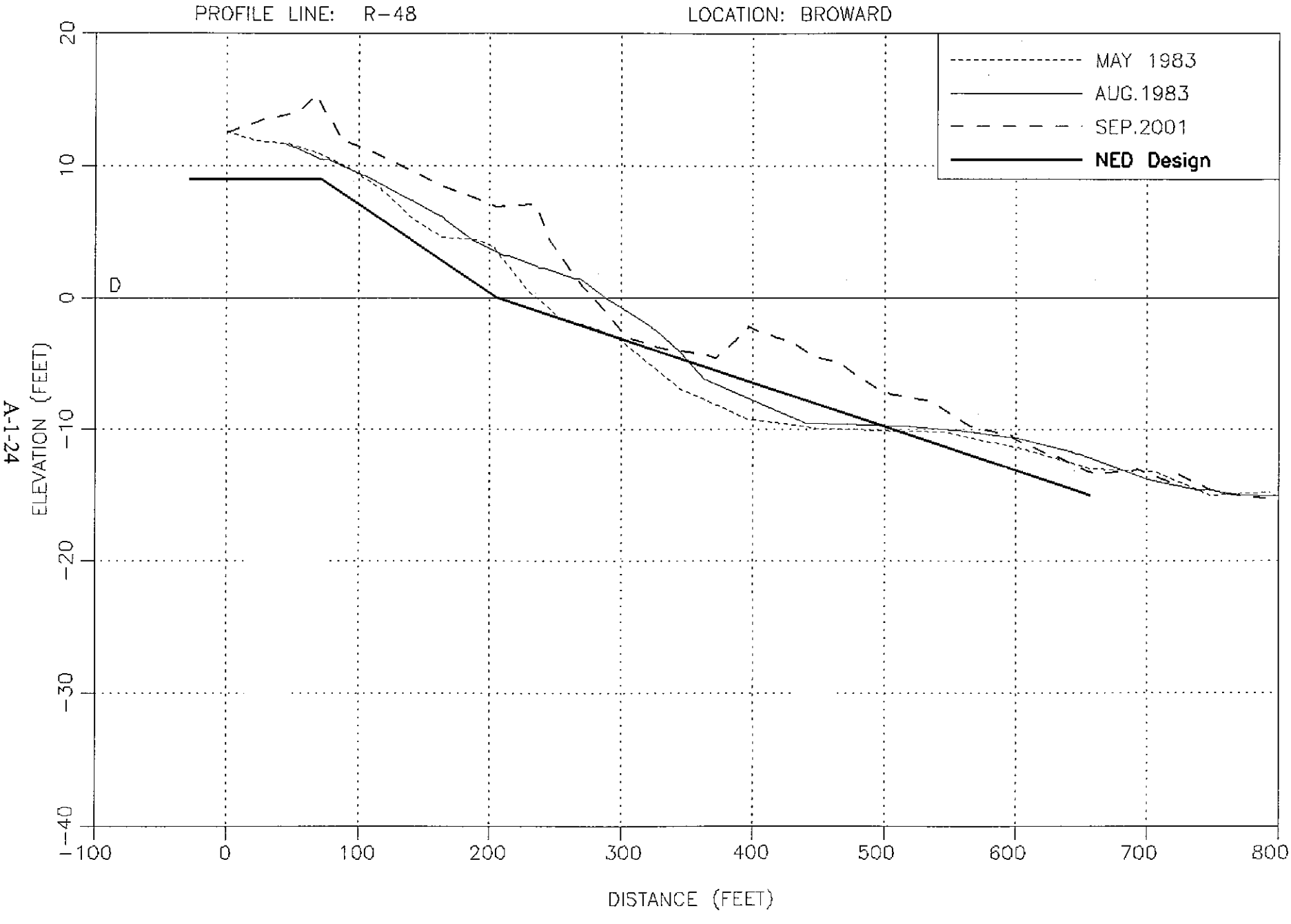
800


PROFILE LINE: R-48
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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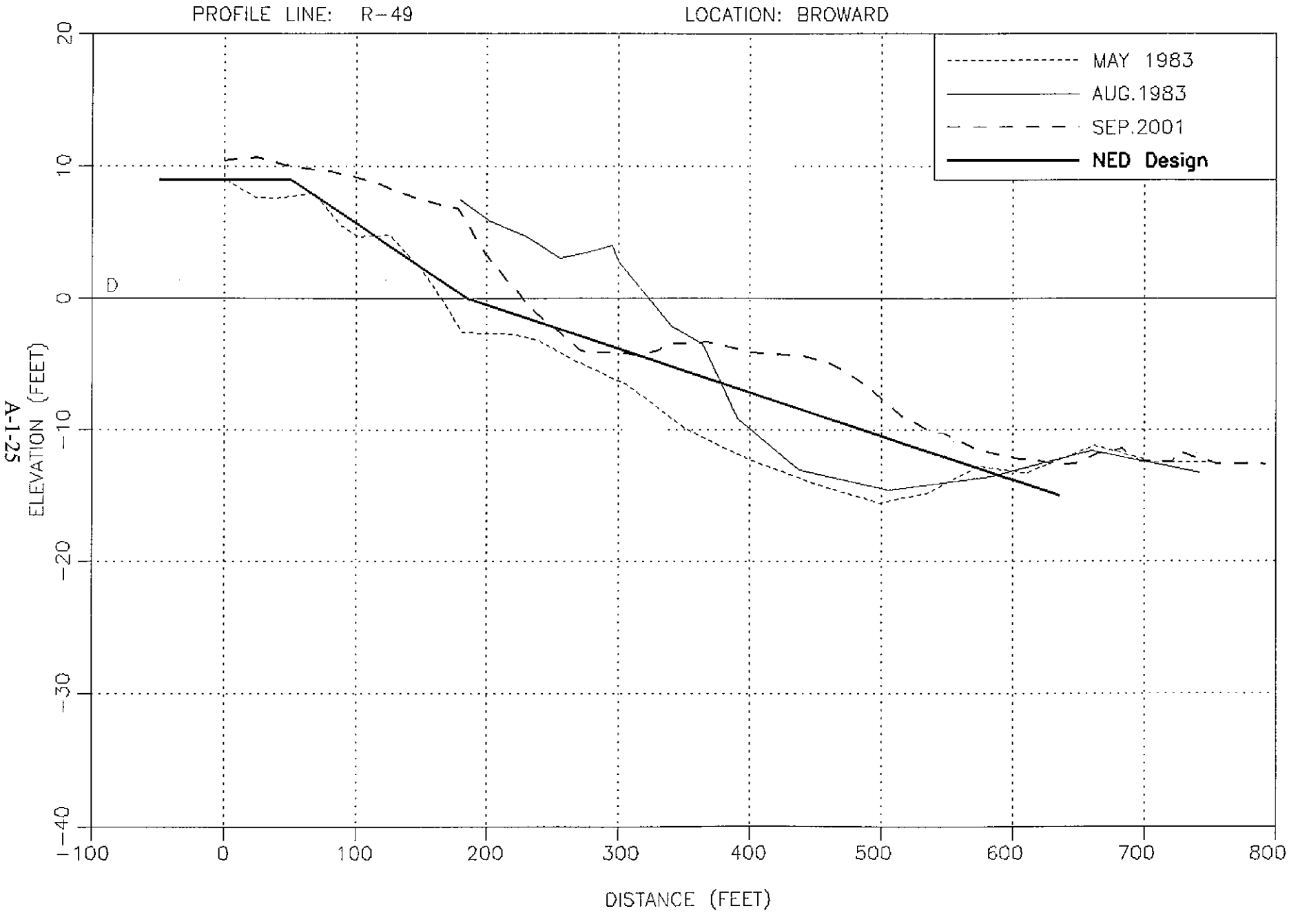
PROFILE LINE: R-49
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
A-1-25
ELEVATION (FEET)
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-40
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300
400
500
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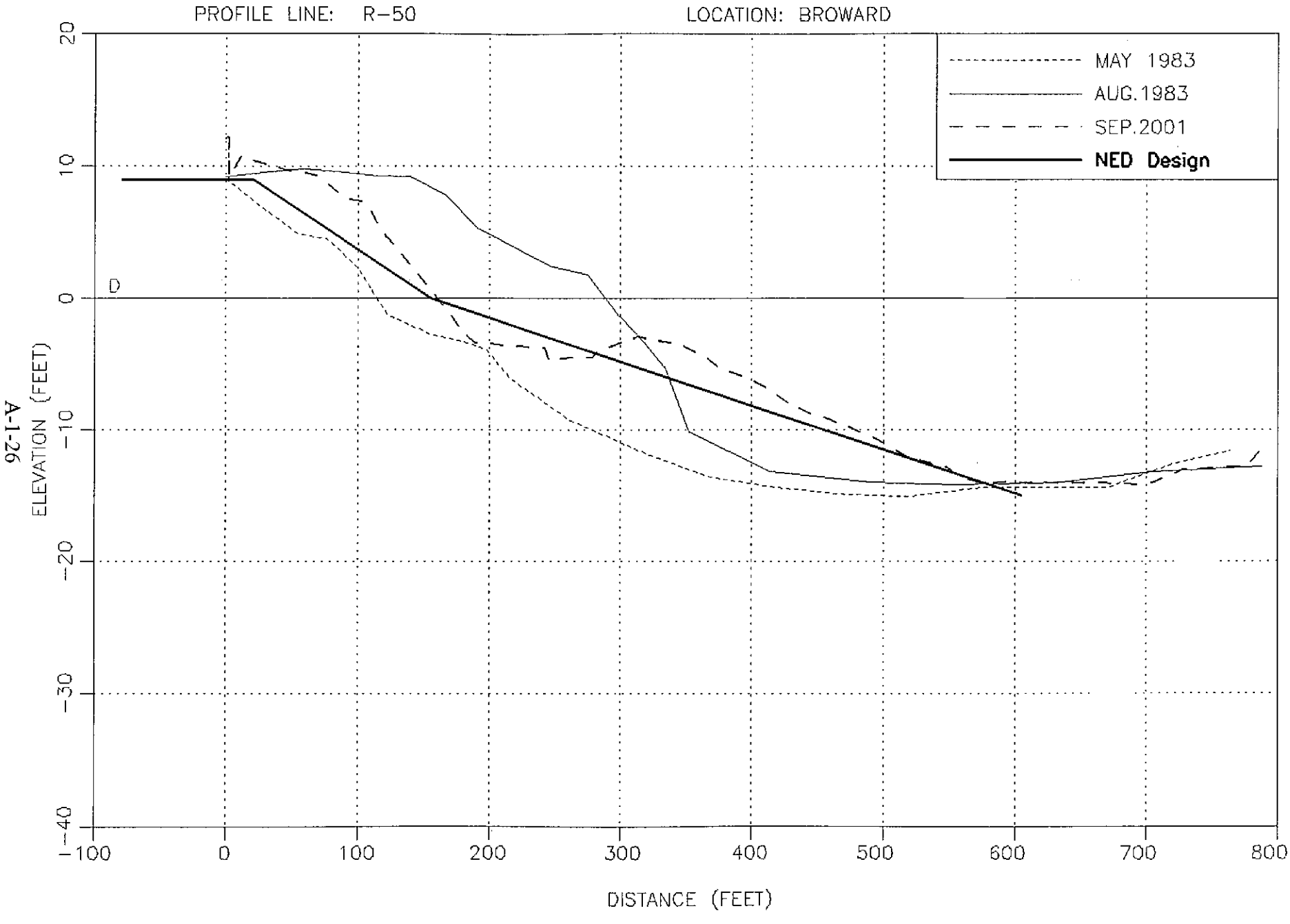
700
800
DISTANCE (FEET)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LOCATION: BROWARD
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AUG.1983
SEP.2001
NED Design
D
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200
300
400
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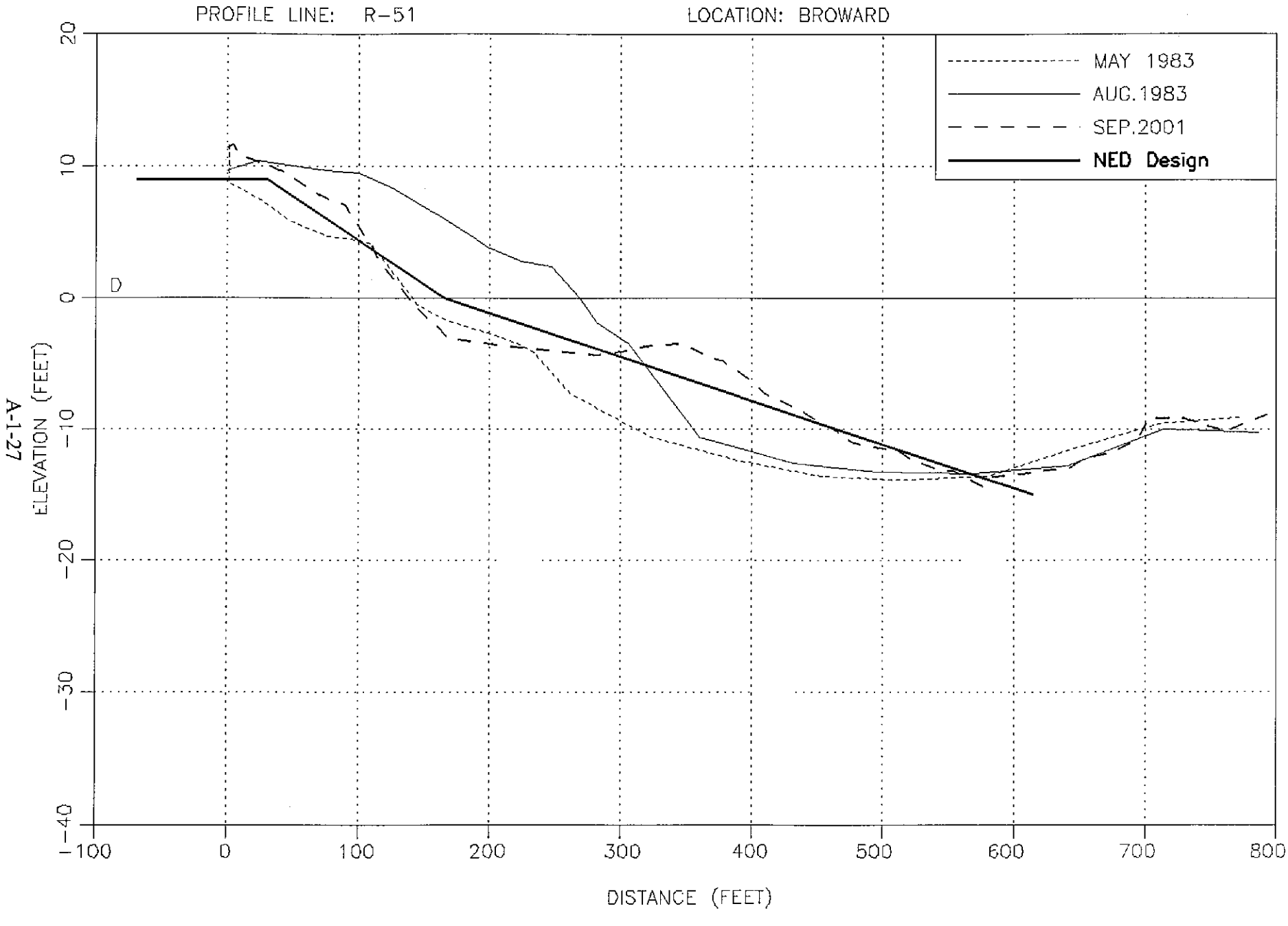
700
800
ELEVATION (FEET)
DISTANCE (FEET)


PROFILE LINE: R-51
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
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10
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-10
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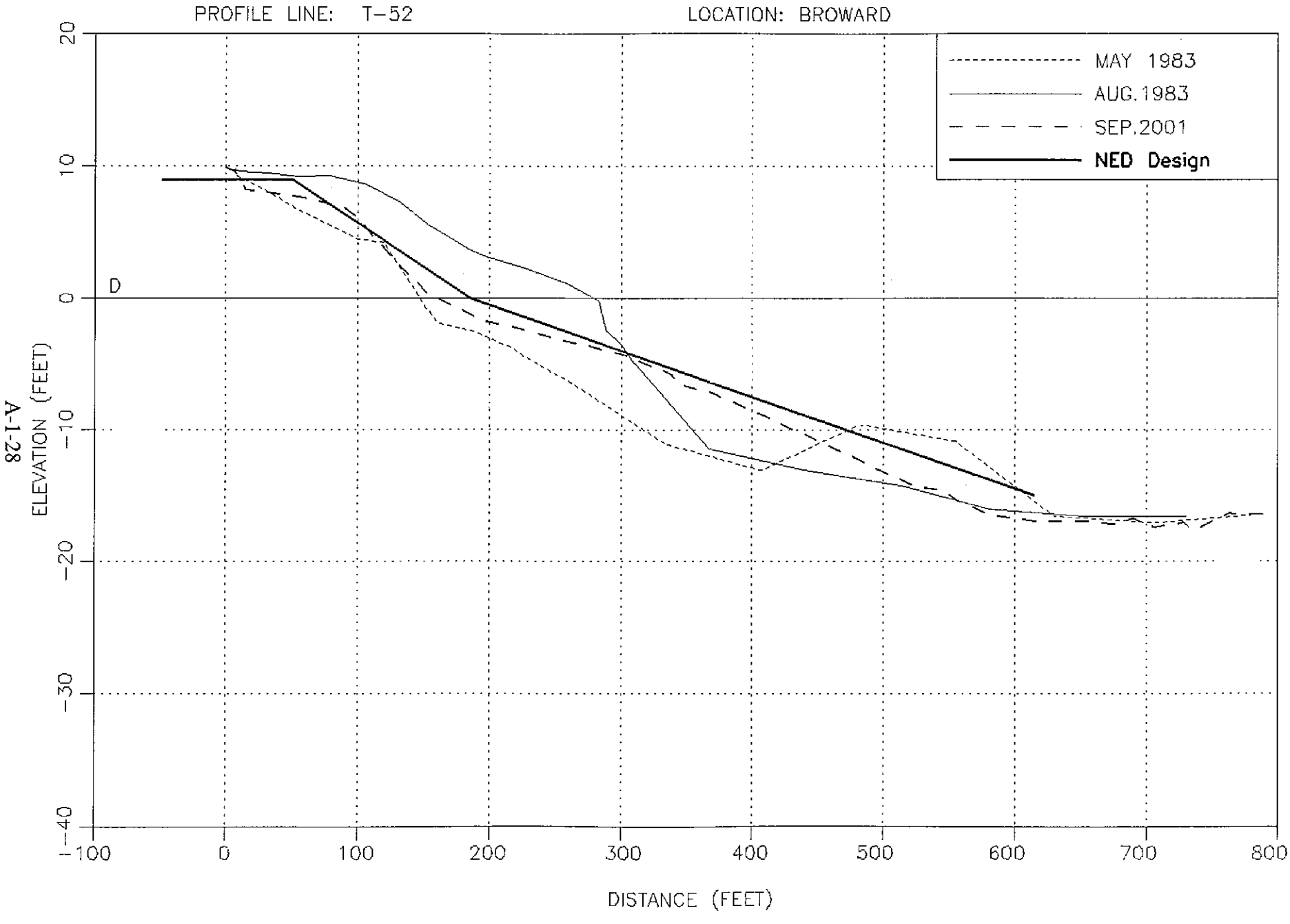
200
300
400
500
600
700
800
ELEVATION (FEET)
DISTANCE (FEET)

A-1-27


PROFILE LINE: T-52
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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-20
-30
-40
-100
0
100
200
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500
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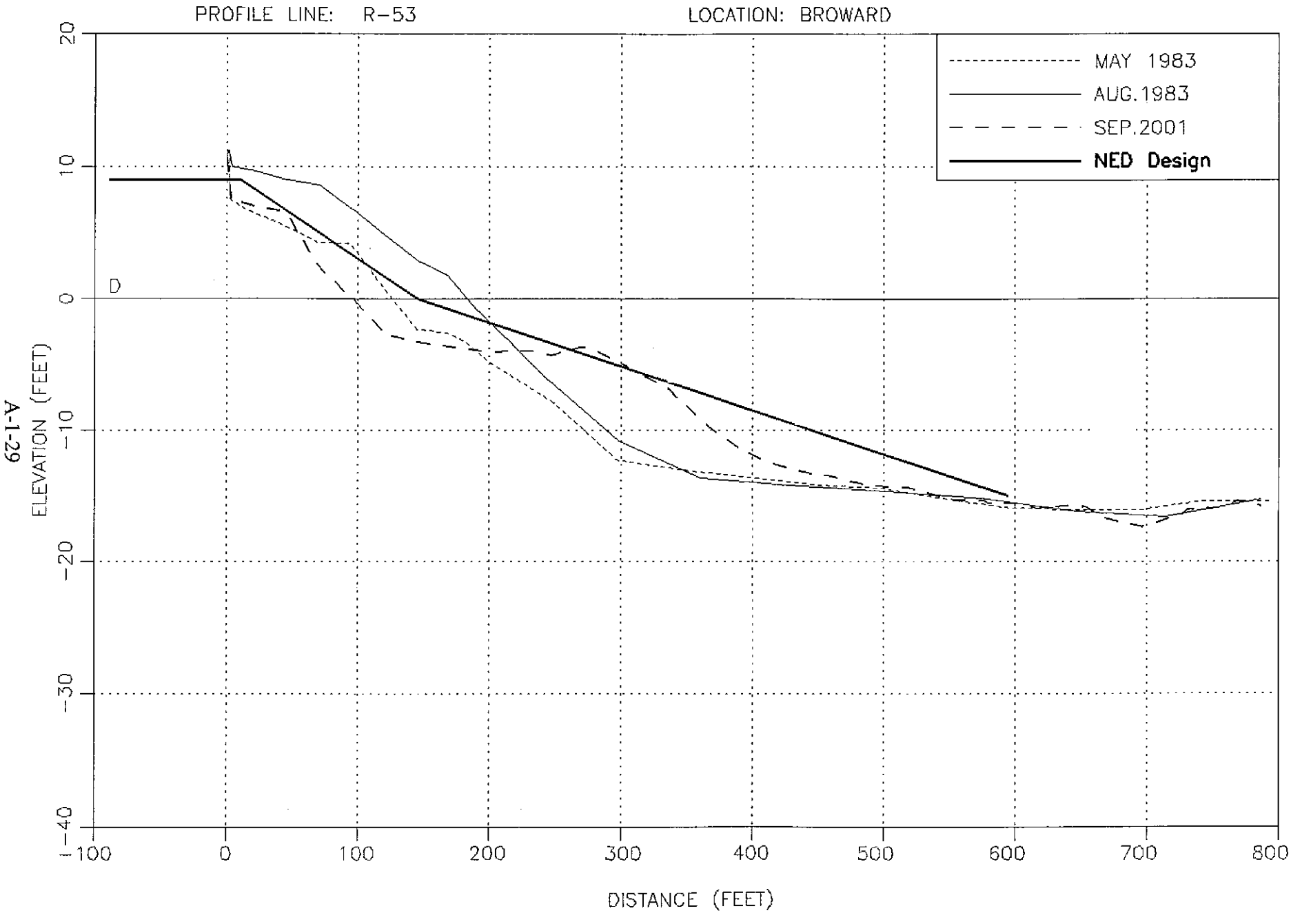
700
800


PROFILE LINE: R-53
LOCATION: BROWARD
MAY 1983
AUG.1983
SEP.2001
NED Design
D
ELEVATION (FEET)
DISTANCE (FEET)
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10
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-10
-20
-30
-40
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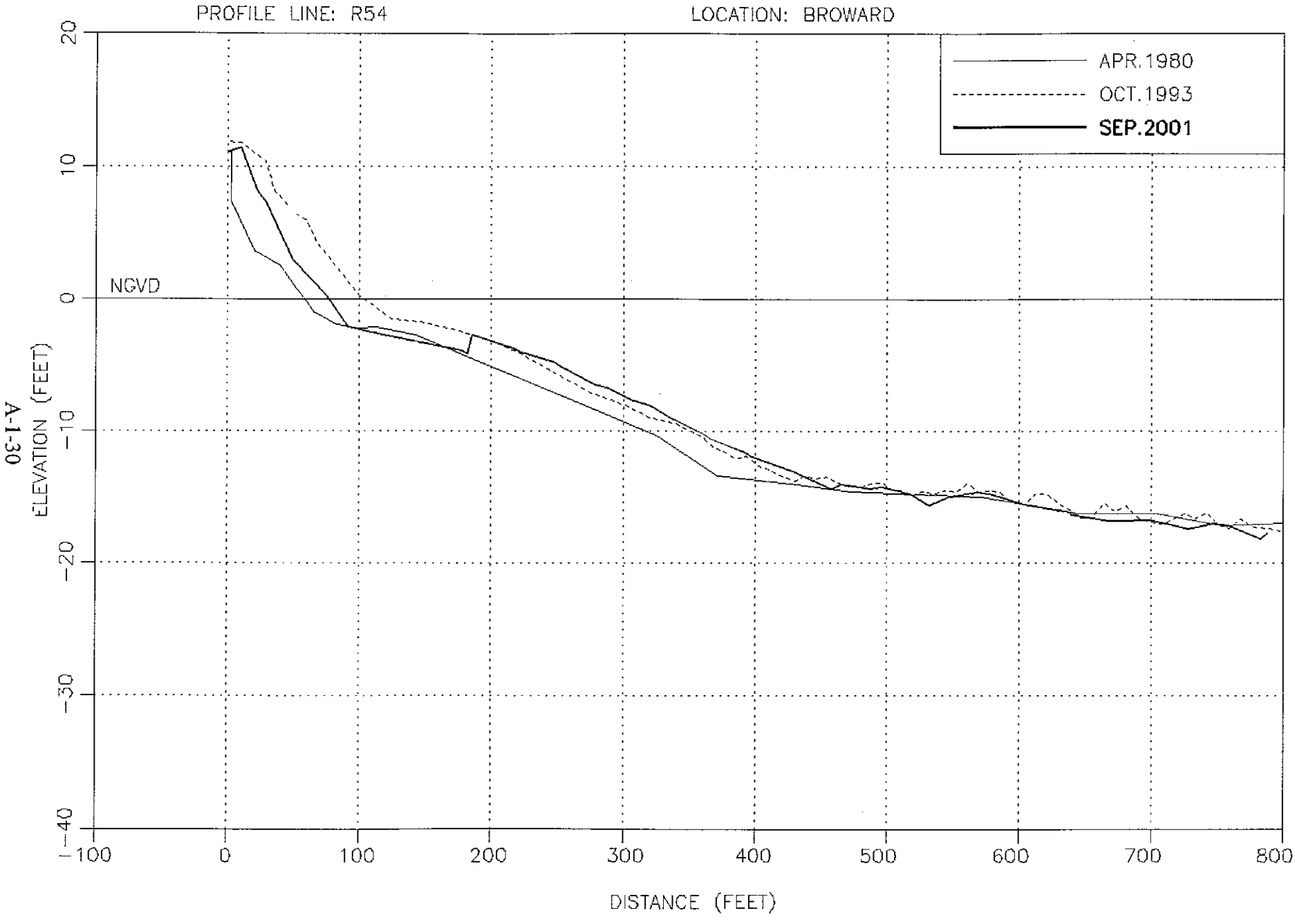
0
100
200
300
400
500
600
700
800

FORT LAUDERDALE

TYPICAL PROJECT CROSS-SECTIONS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LOCATION: BROWARD
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OCT.1993
SEP.2001
NGVD
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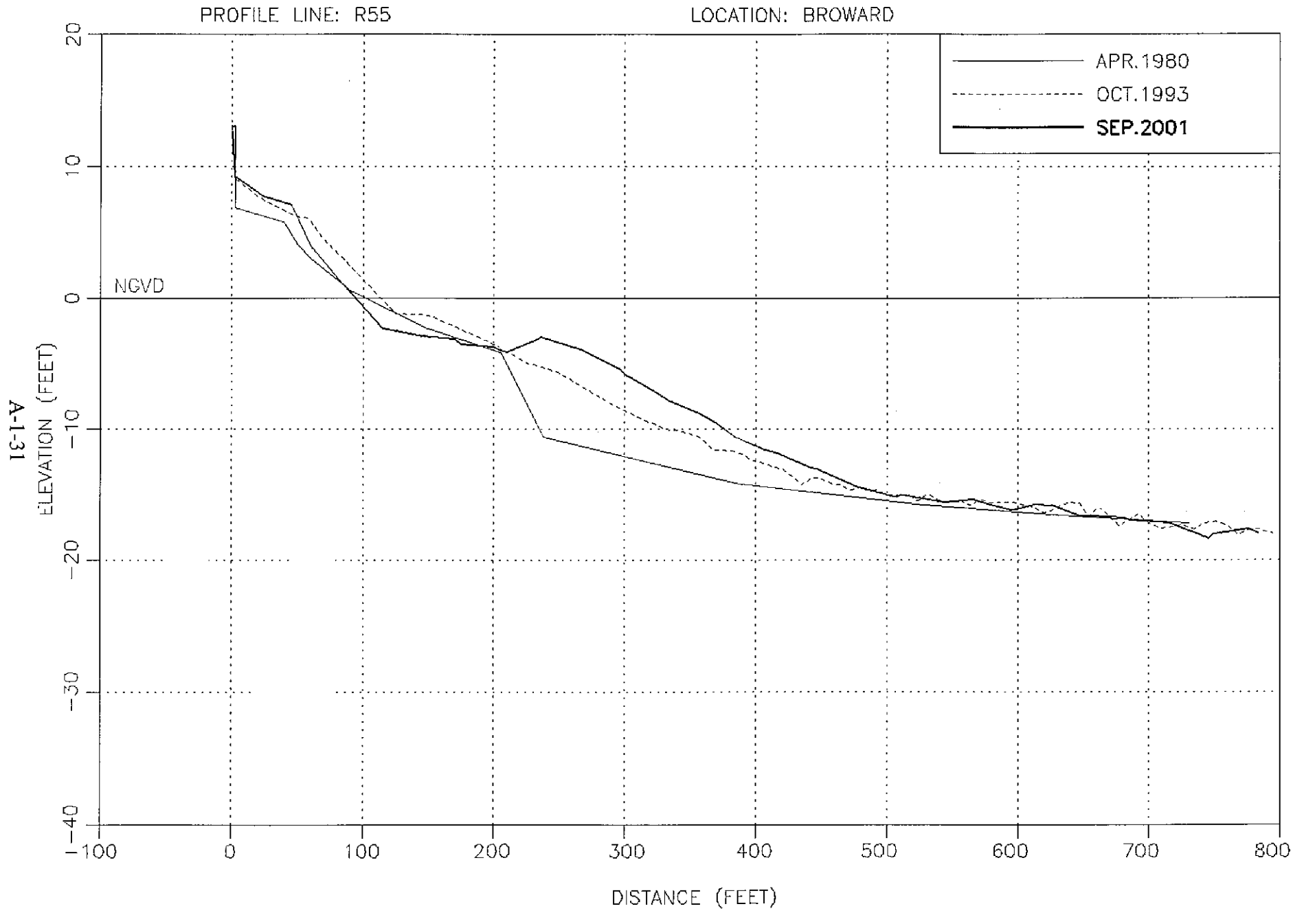
0
100
200
300
400
500
600
700
800
DISTANCE (FEET)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OCT.1993
SEP.2001
NGVD
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700
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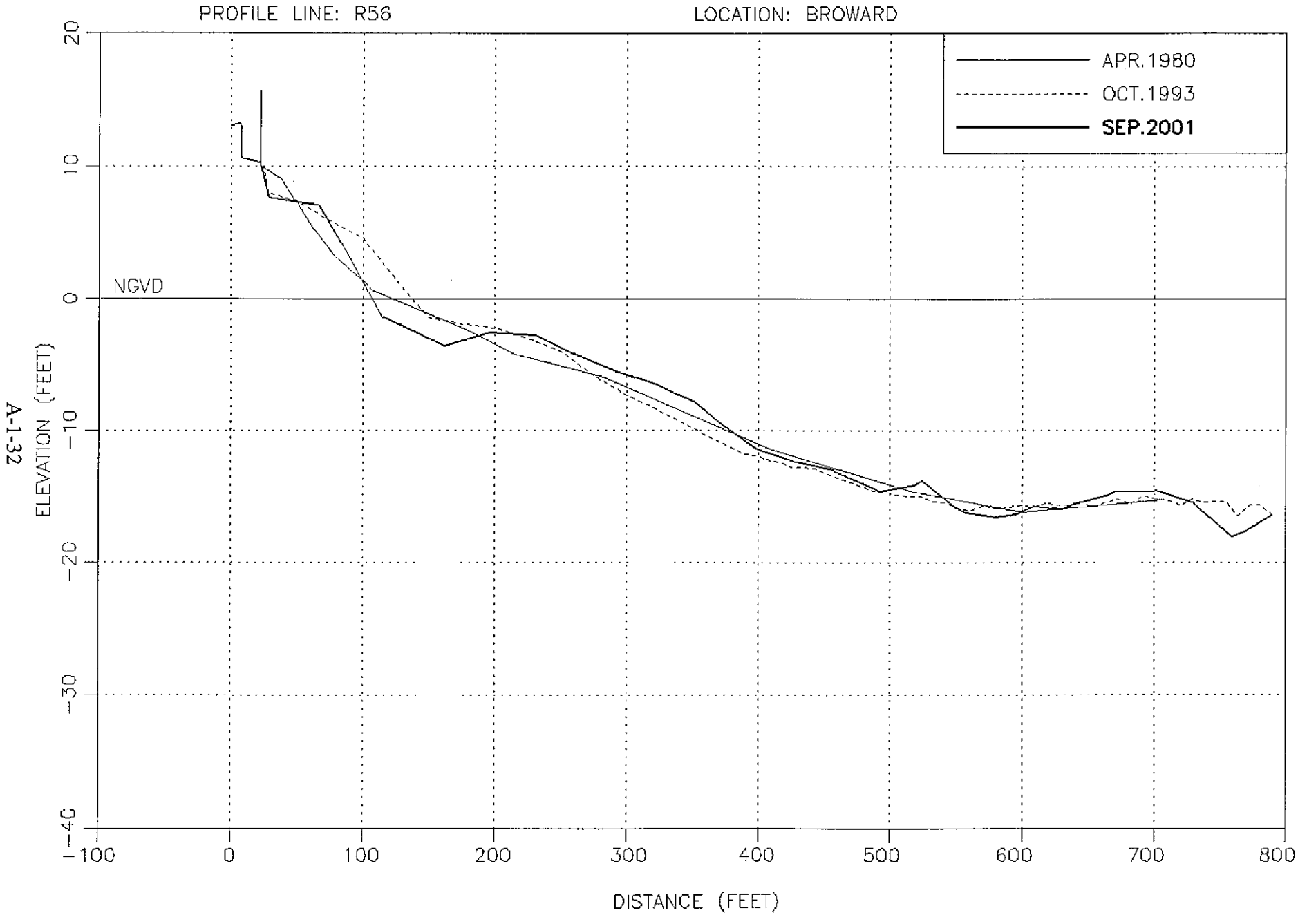
ELEVATION (FEET)
DISTANCE (FEET)


PROFILE LINE: R56
LOCATION: BROWARD
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OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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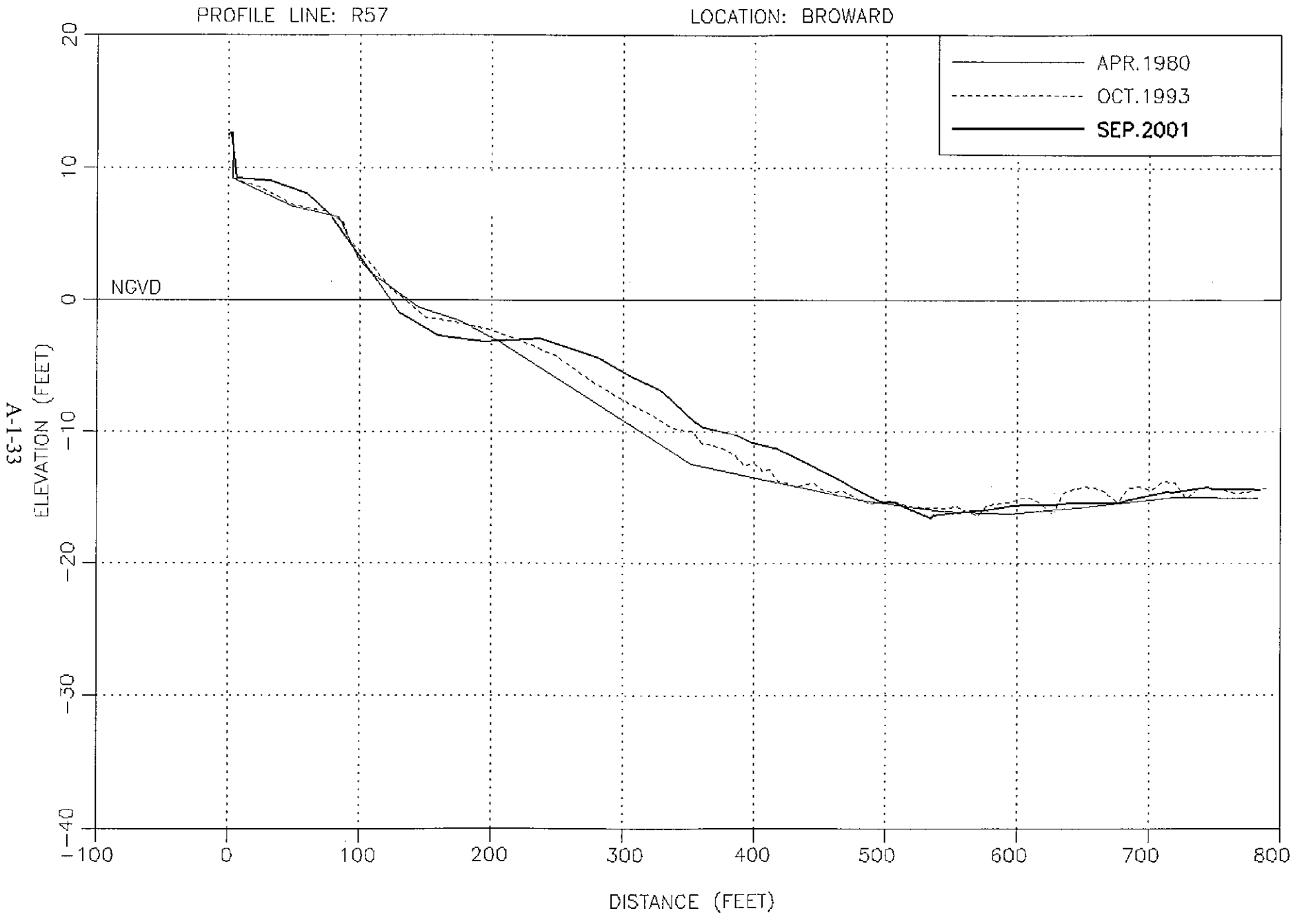
600
700
800


PROFILE LINE: R57
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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-30
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0
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200
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400
500
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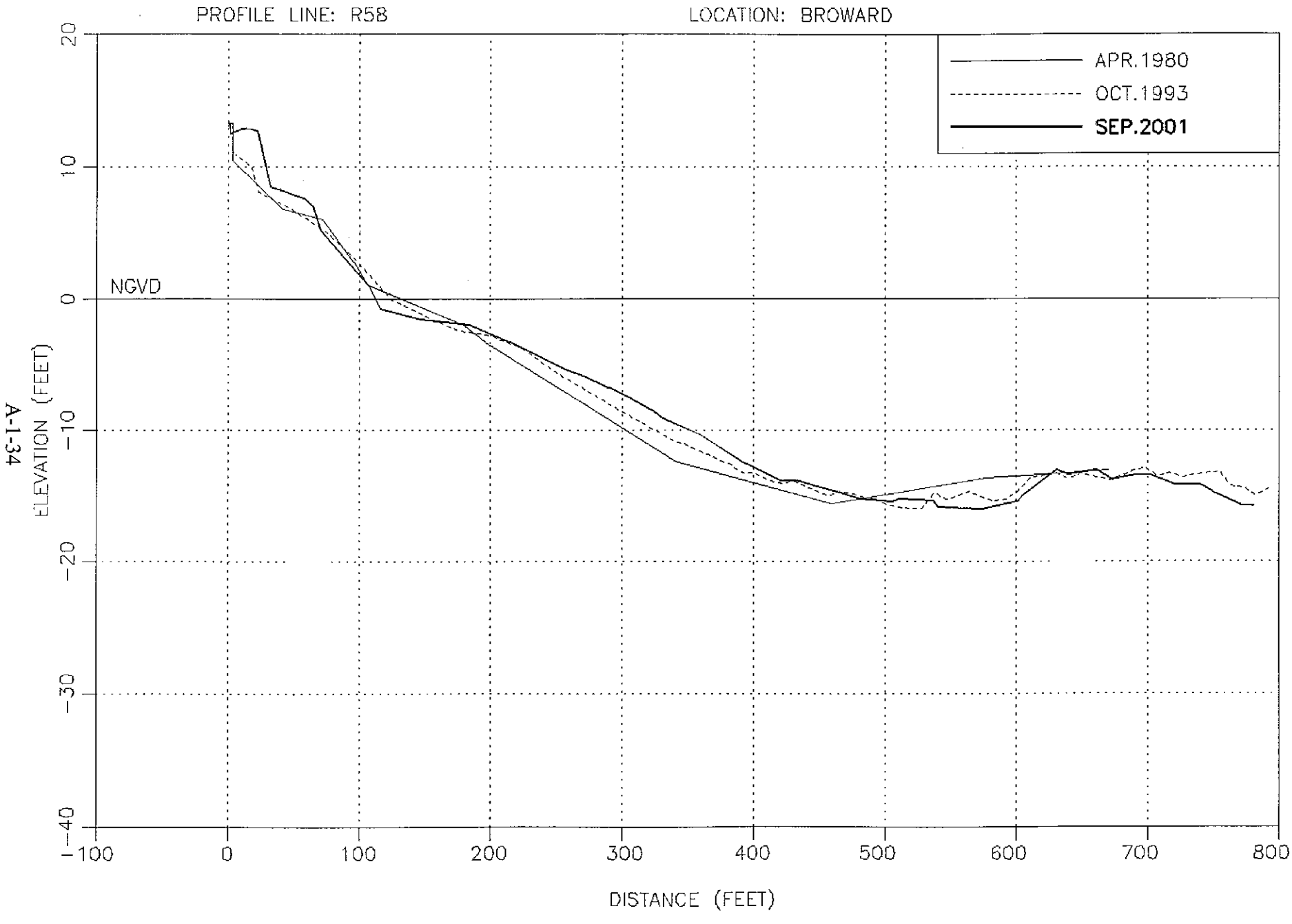
800
DISTANCE (FEET)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LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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-100
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100
200
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400
500
600
700
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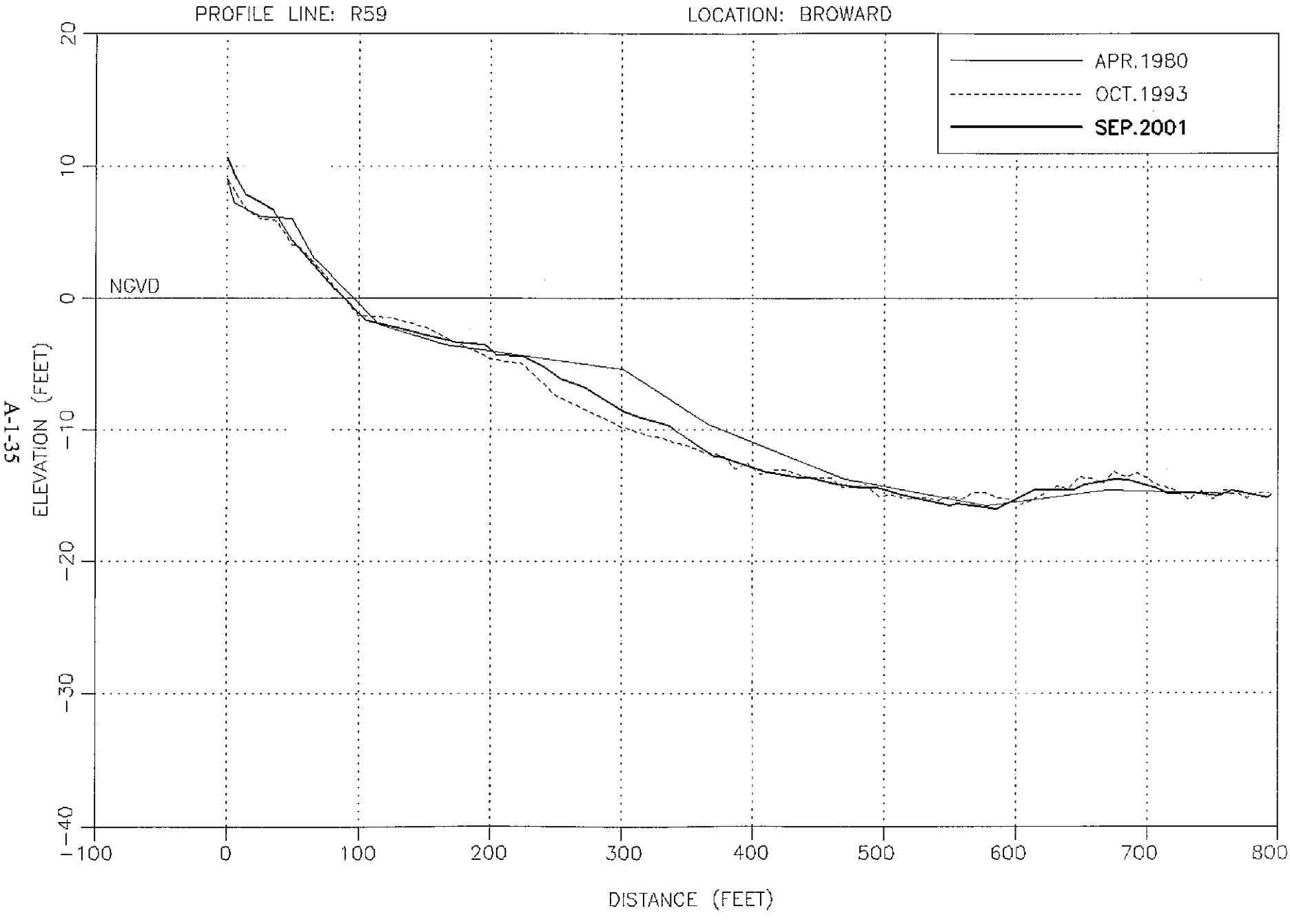
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OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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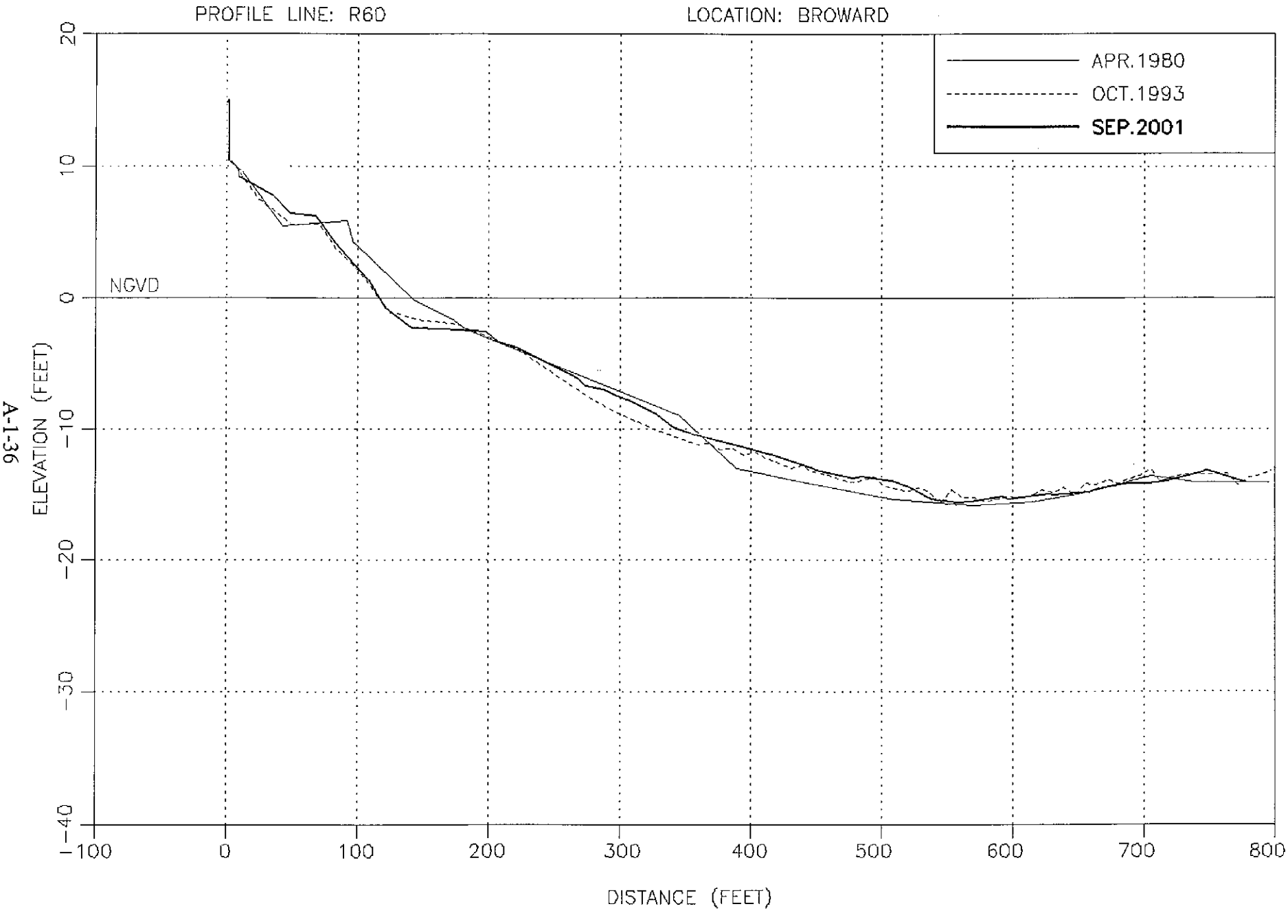
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R60
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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-100
0
100
200
300
400
500
600
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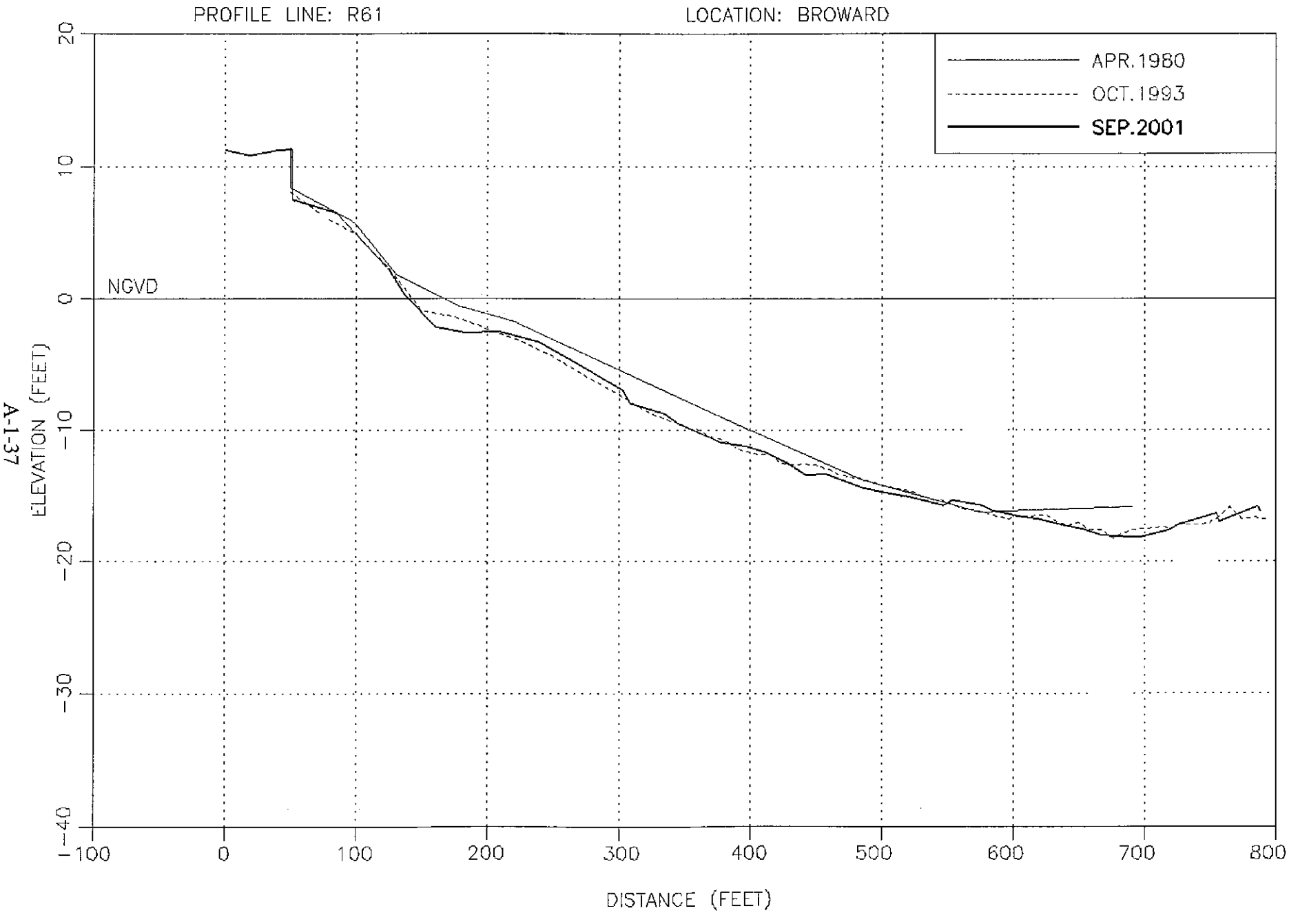
800


PROFILE LINE: R61
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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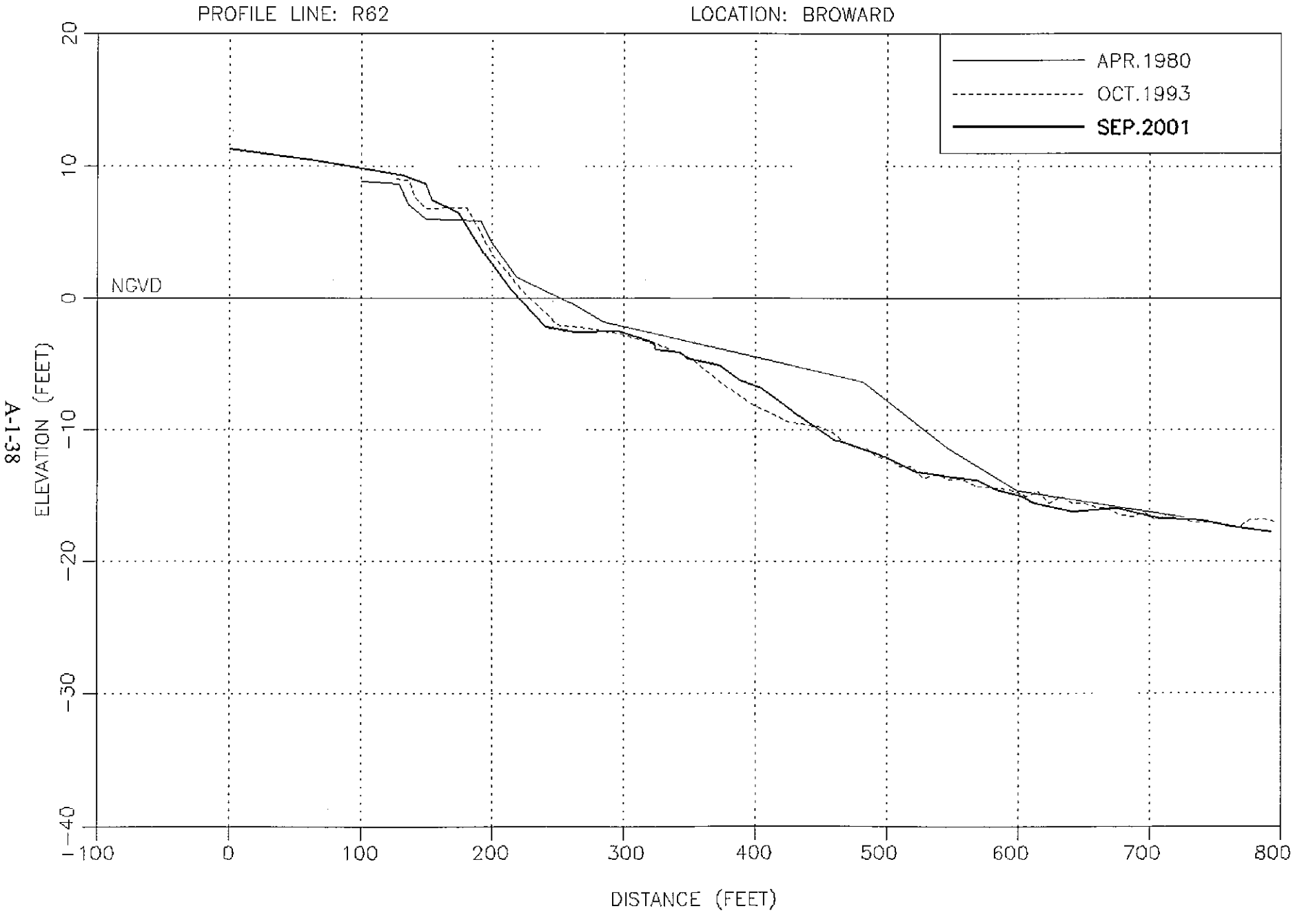
300
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R62
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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200
300
400
500
600
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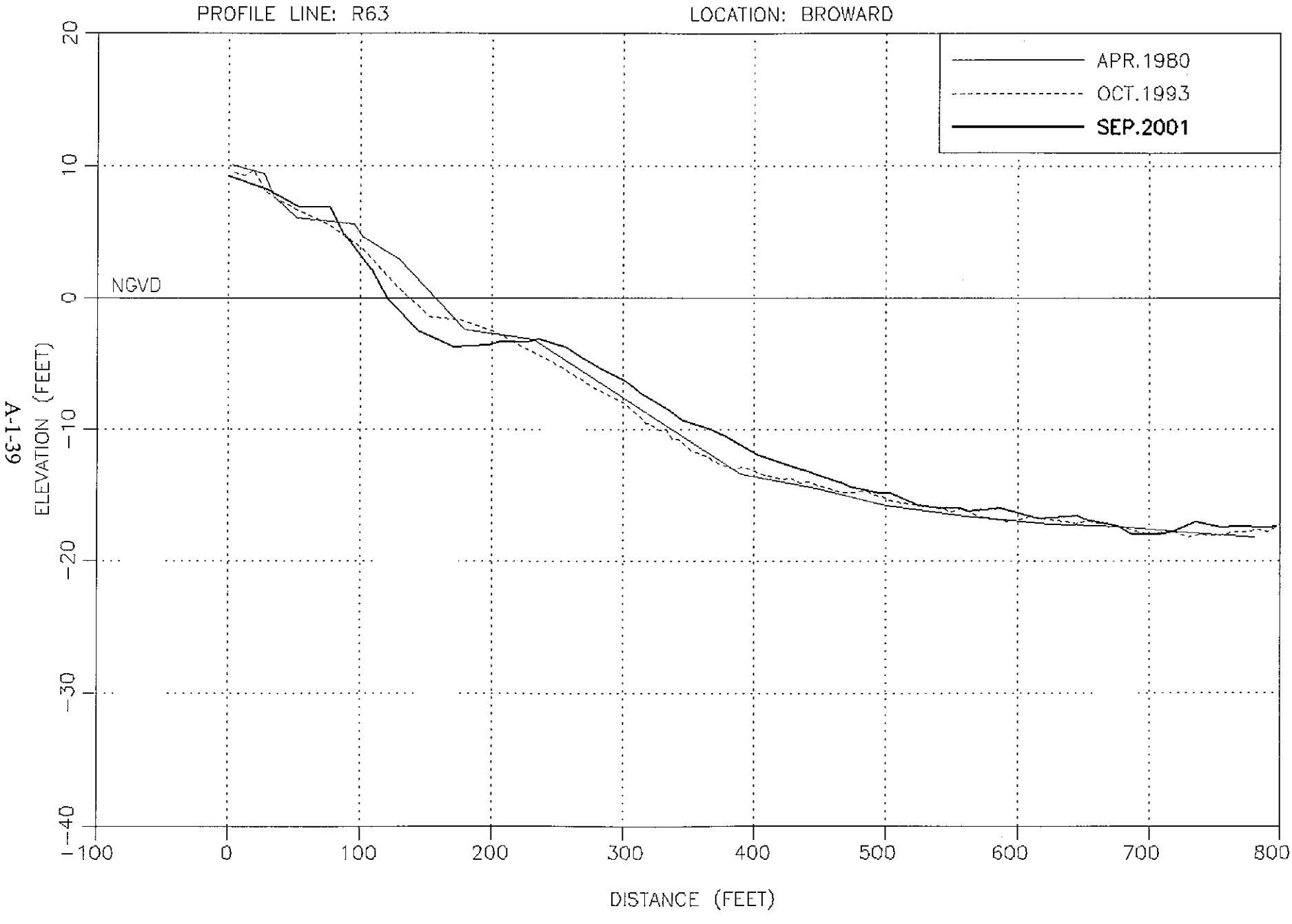
800
DISTANCE (FEET)


PROFILE LINE: R63
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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-100
0
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200
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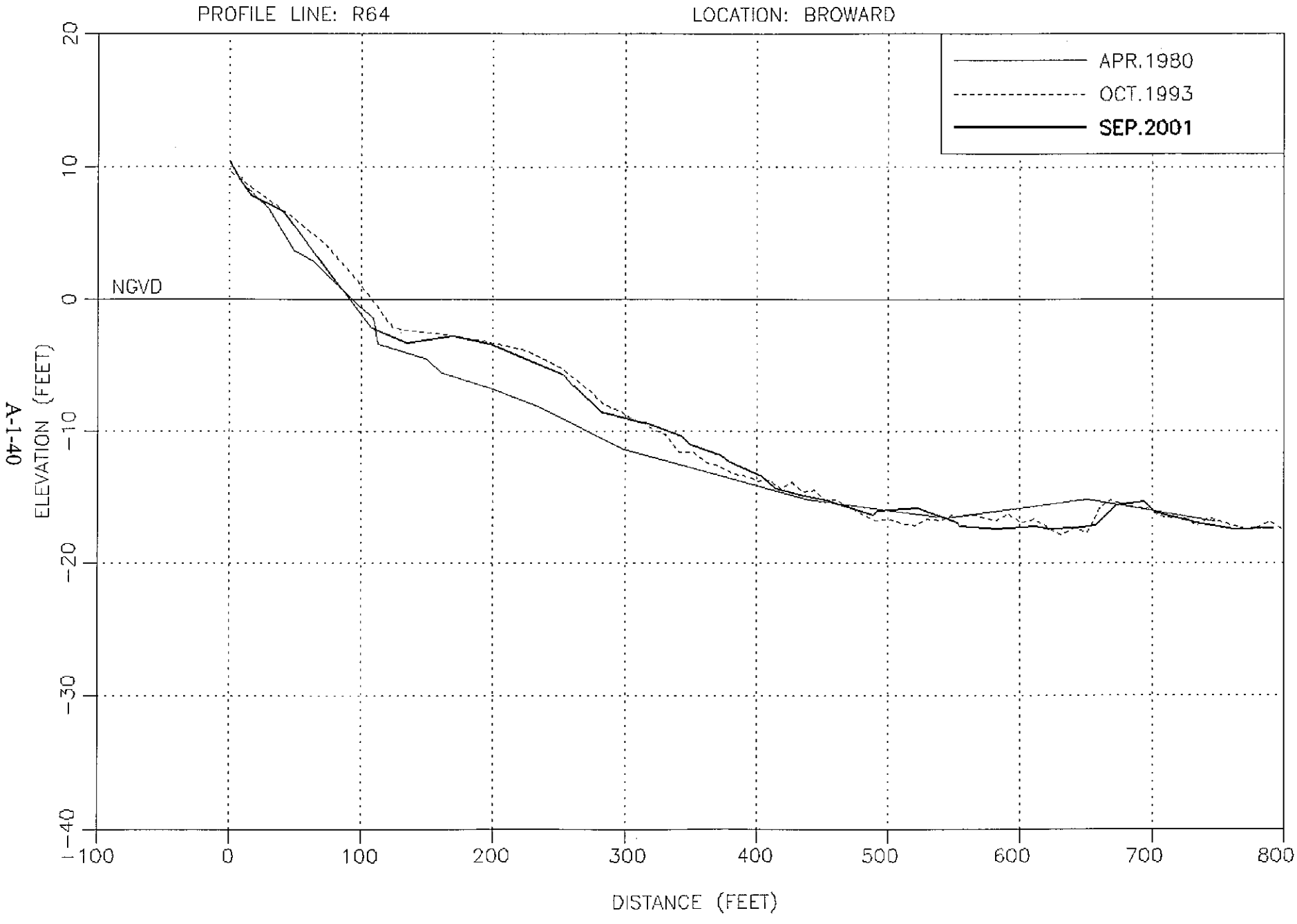
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R64
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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300
400
500
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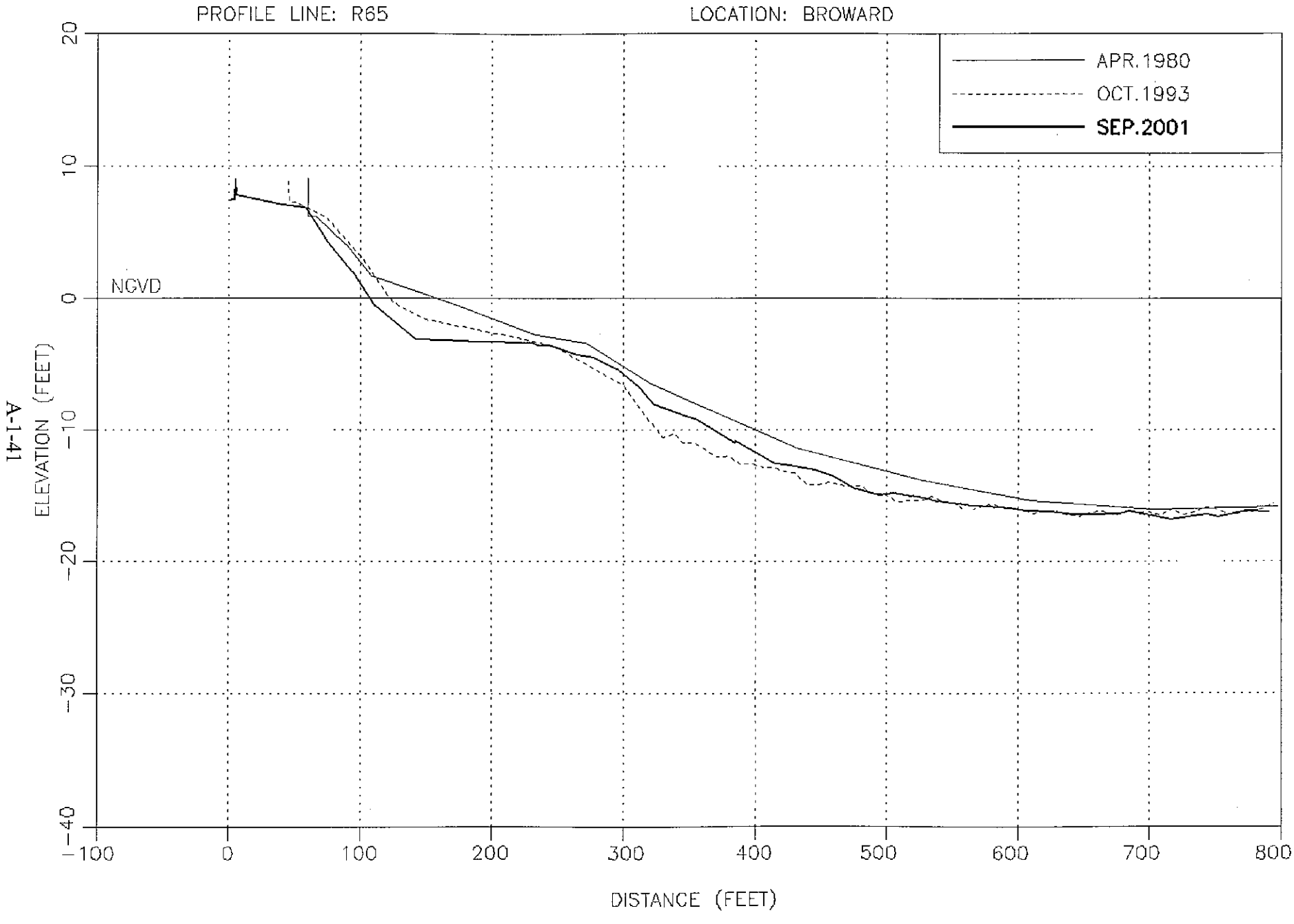
700
800
DISTANCE (FEET)


PROFILE LINE: R65
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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-10
-20
-30
-40
-100
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200
300
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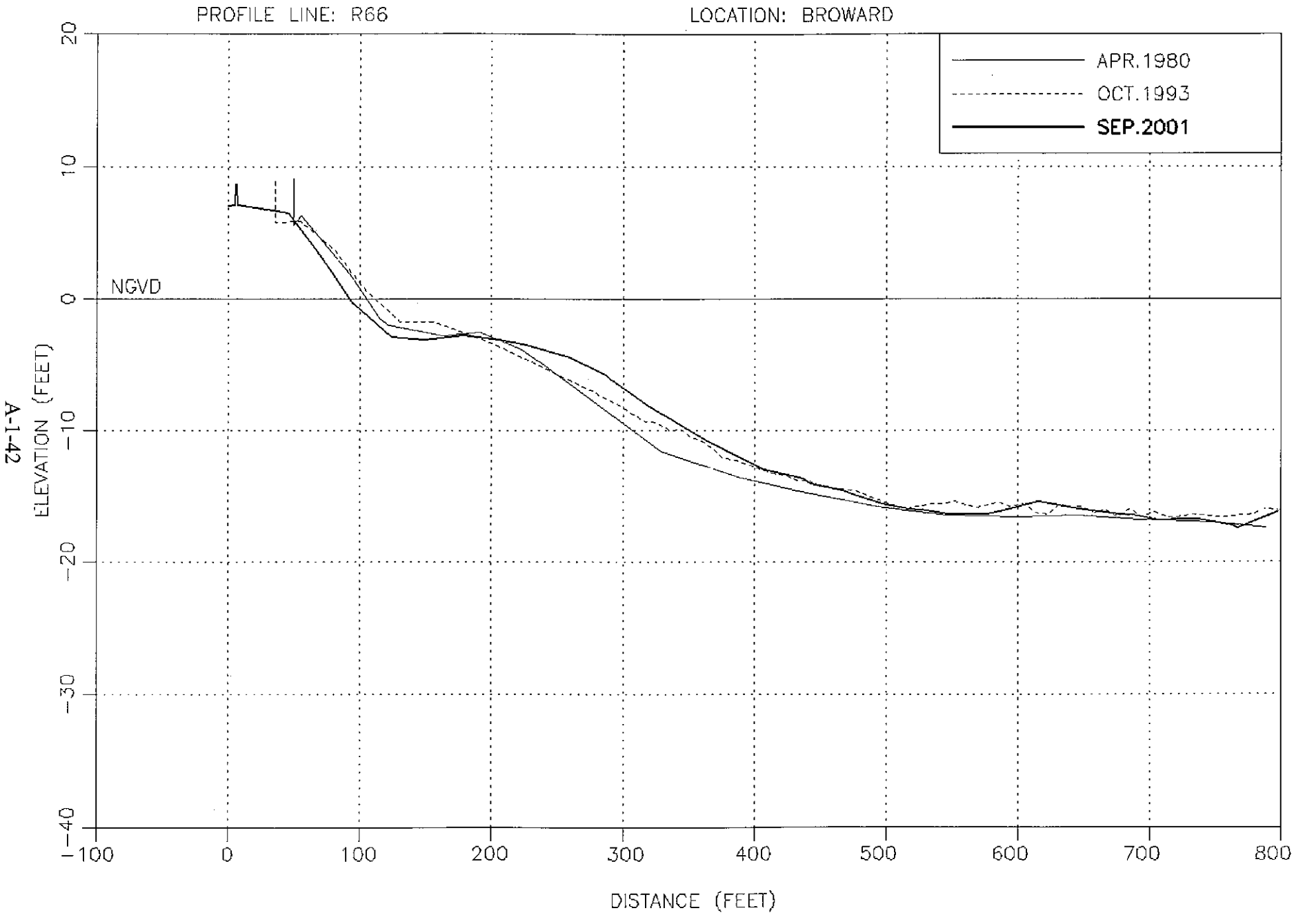
700
800


PROFILE LINE: R66
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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-10
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-30
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-100
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200
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400
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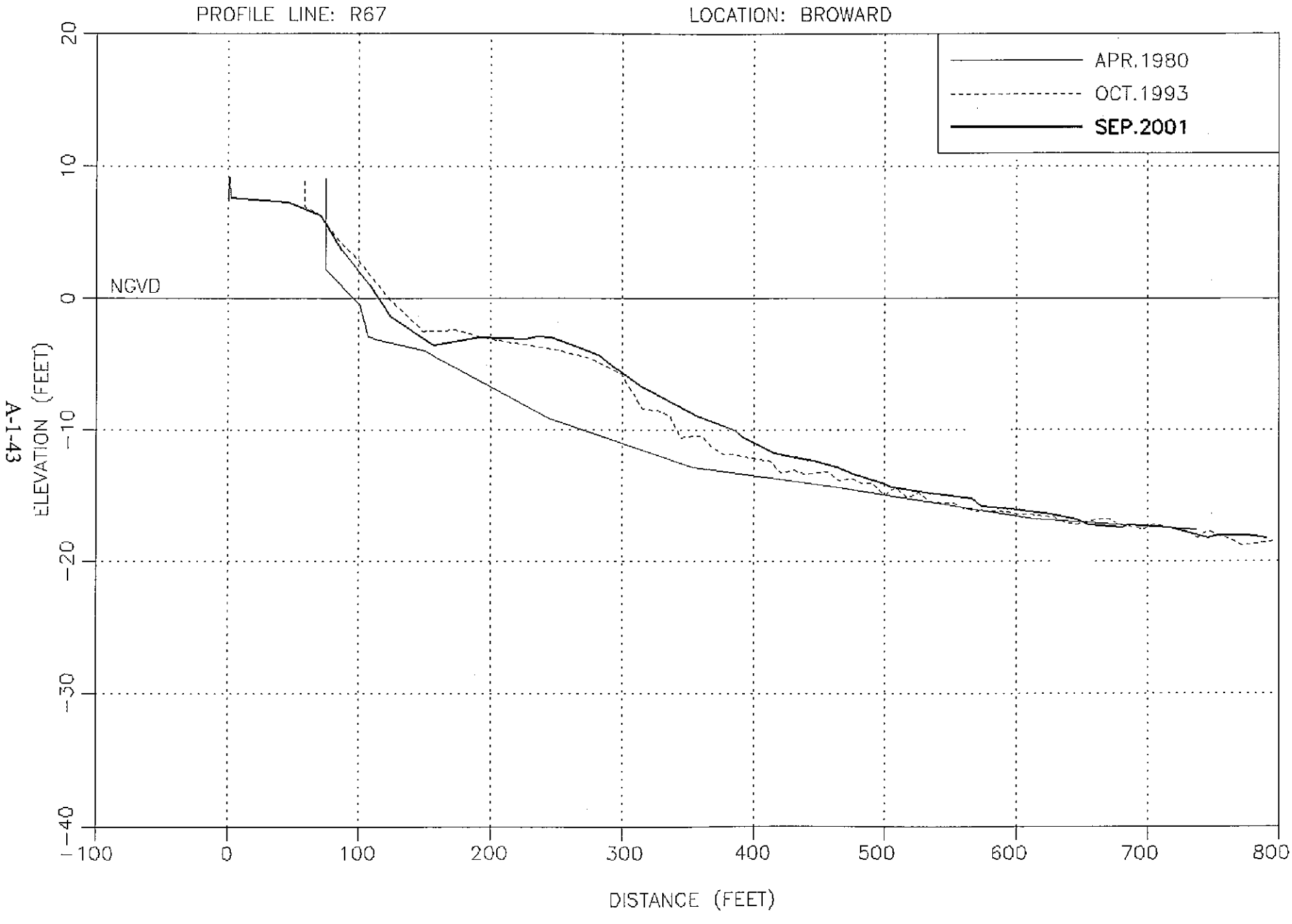
600
700
800
DISTANCE (FEET)


PROFILE LINE: R67
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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300
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500
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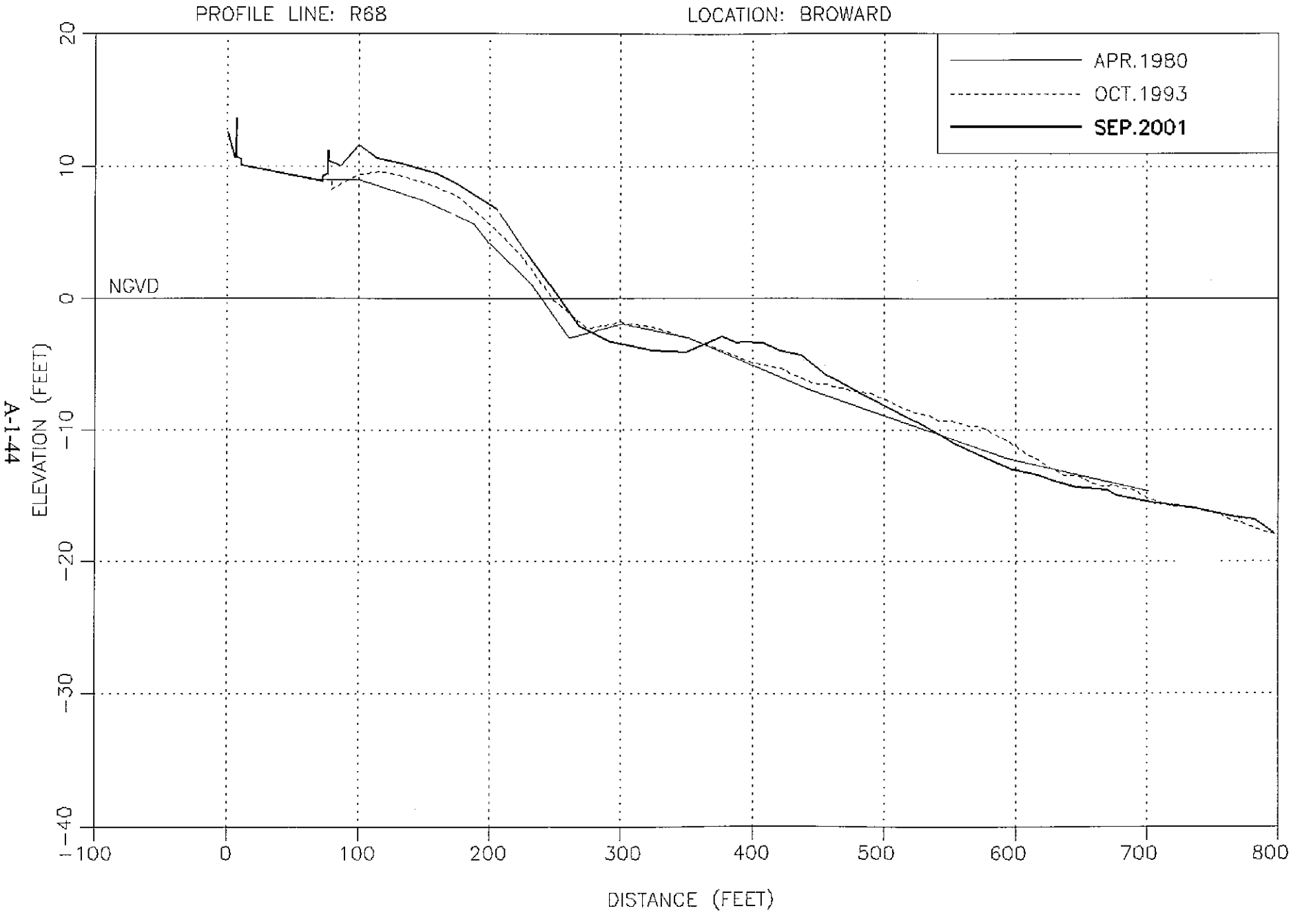
700
800


PROFILE LINE: R68
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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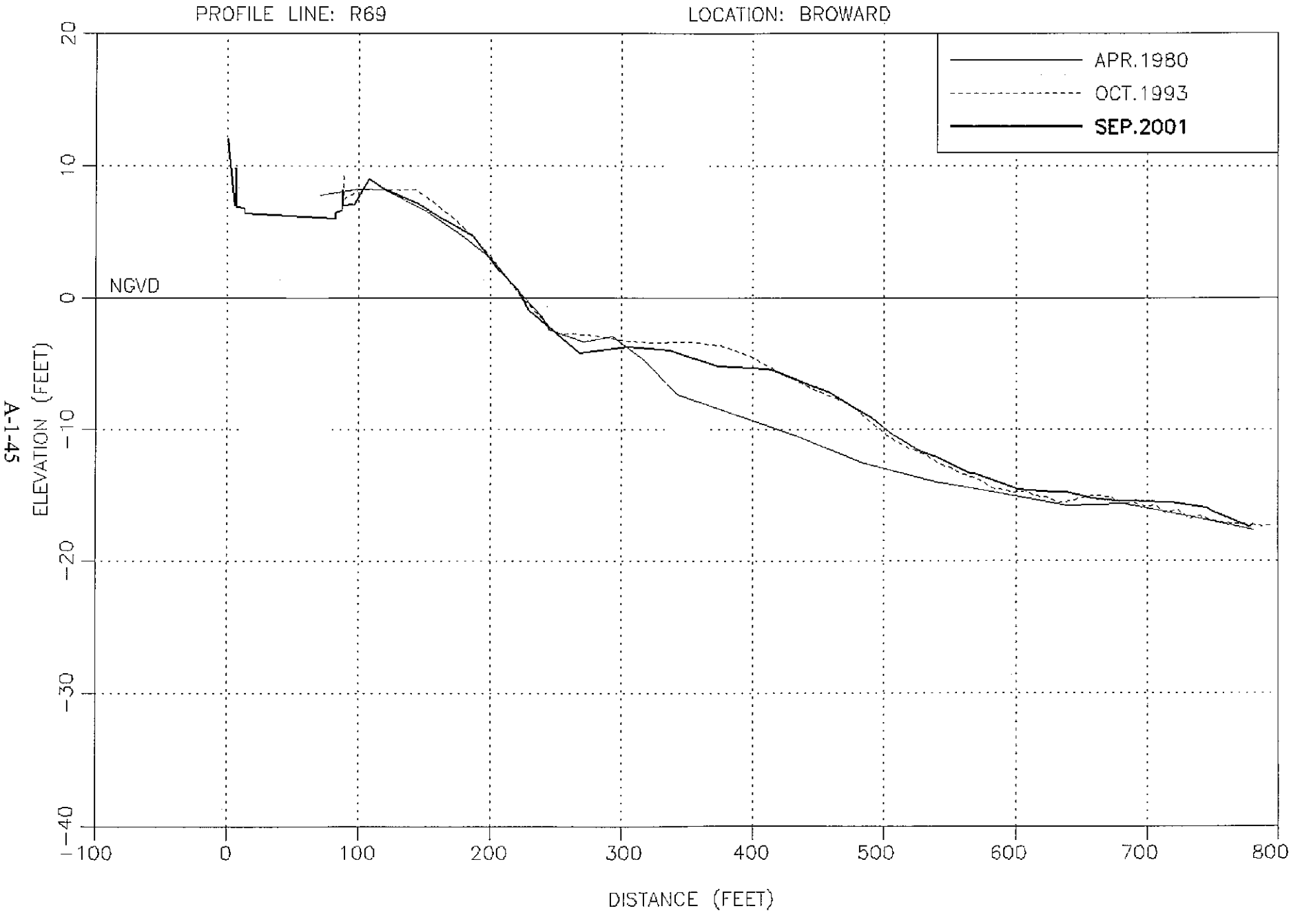
200
300
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R69
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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-20
-30
-40
-100
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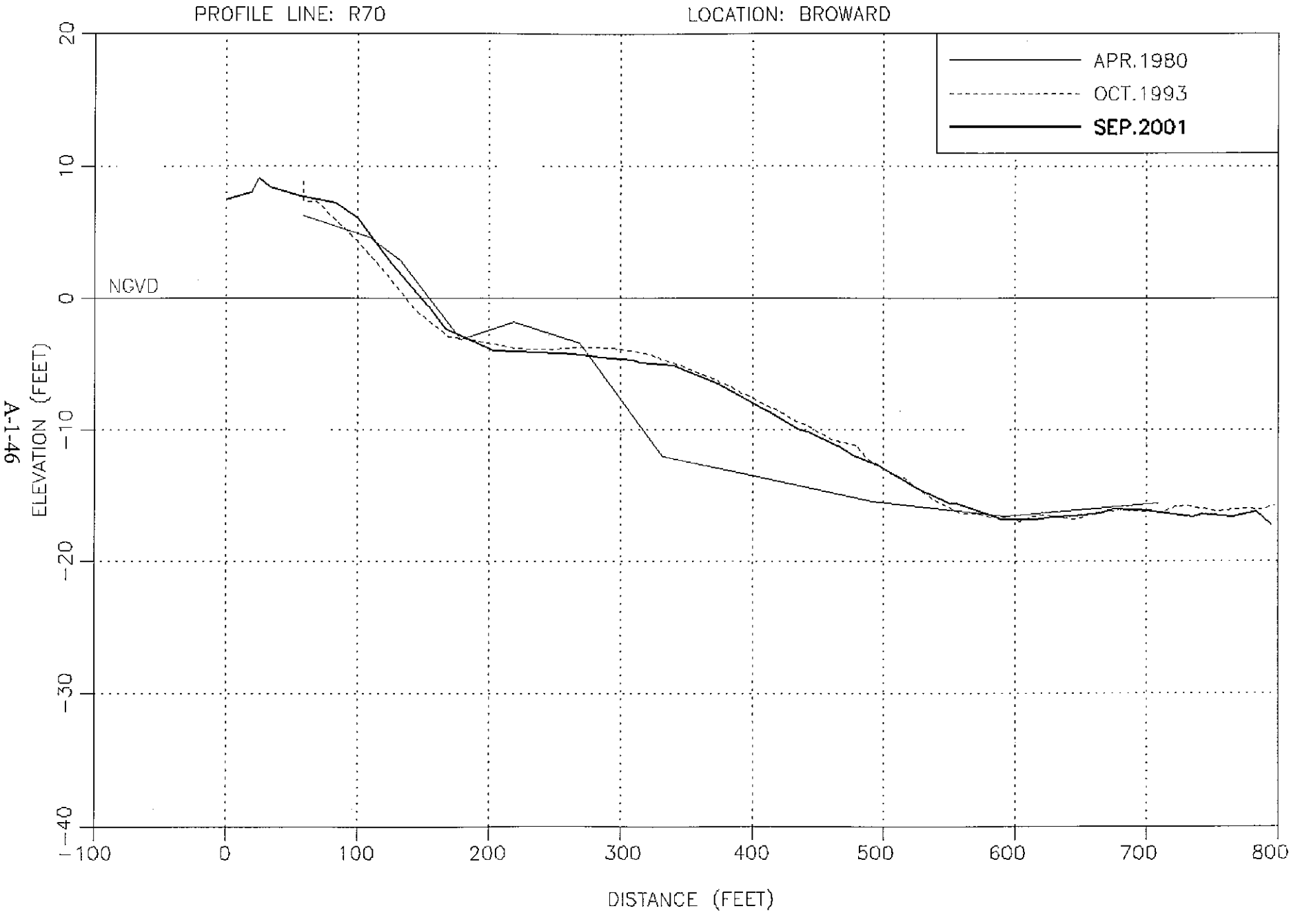
100
200
300
400
500
600
700
800


PROFILE LINE: R70
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
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-100
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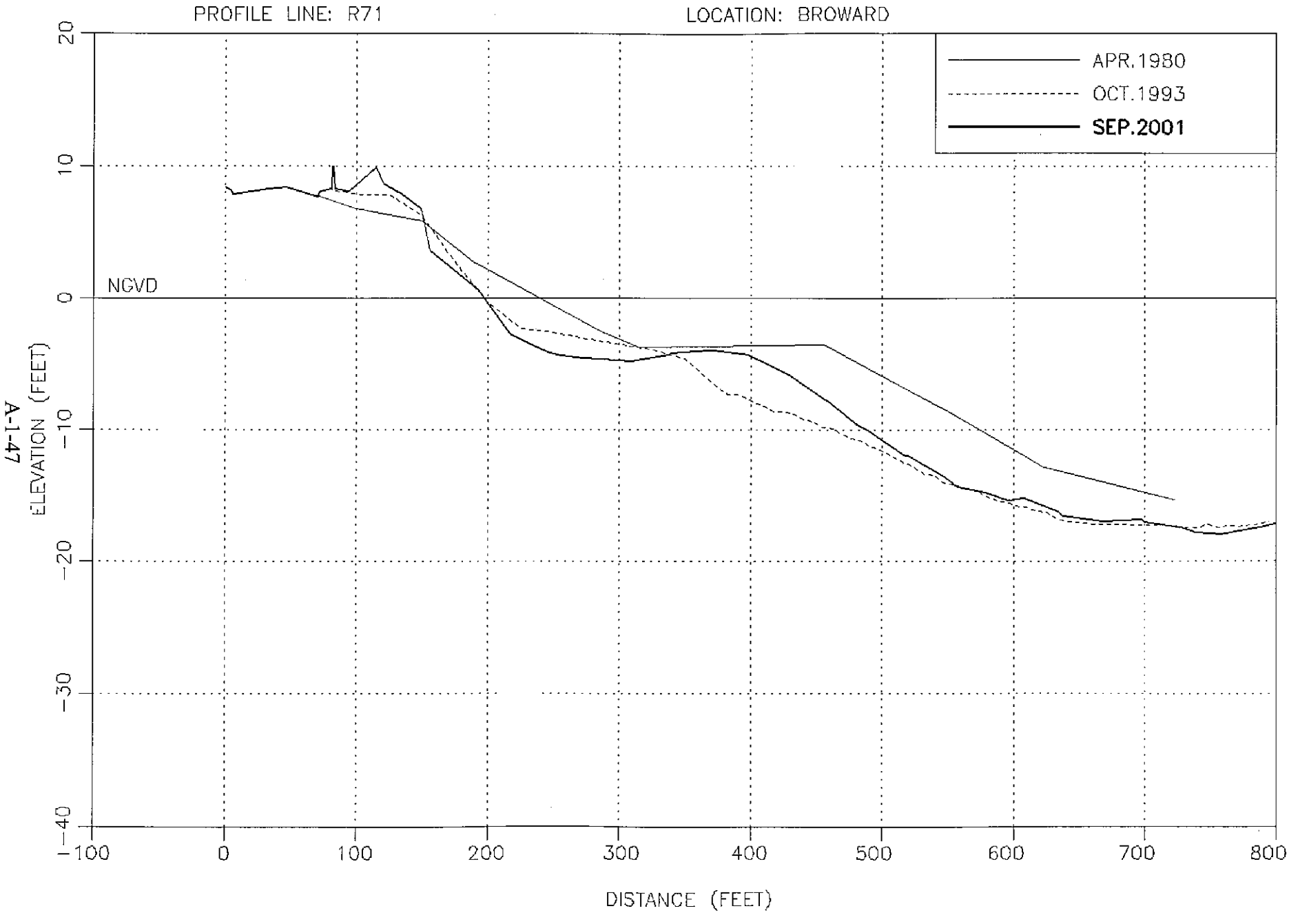
100
200
300
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R71
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
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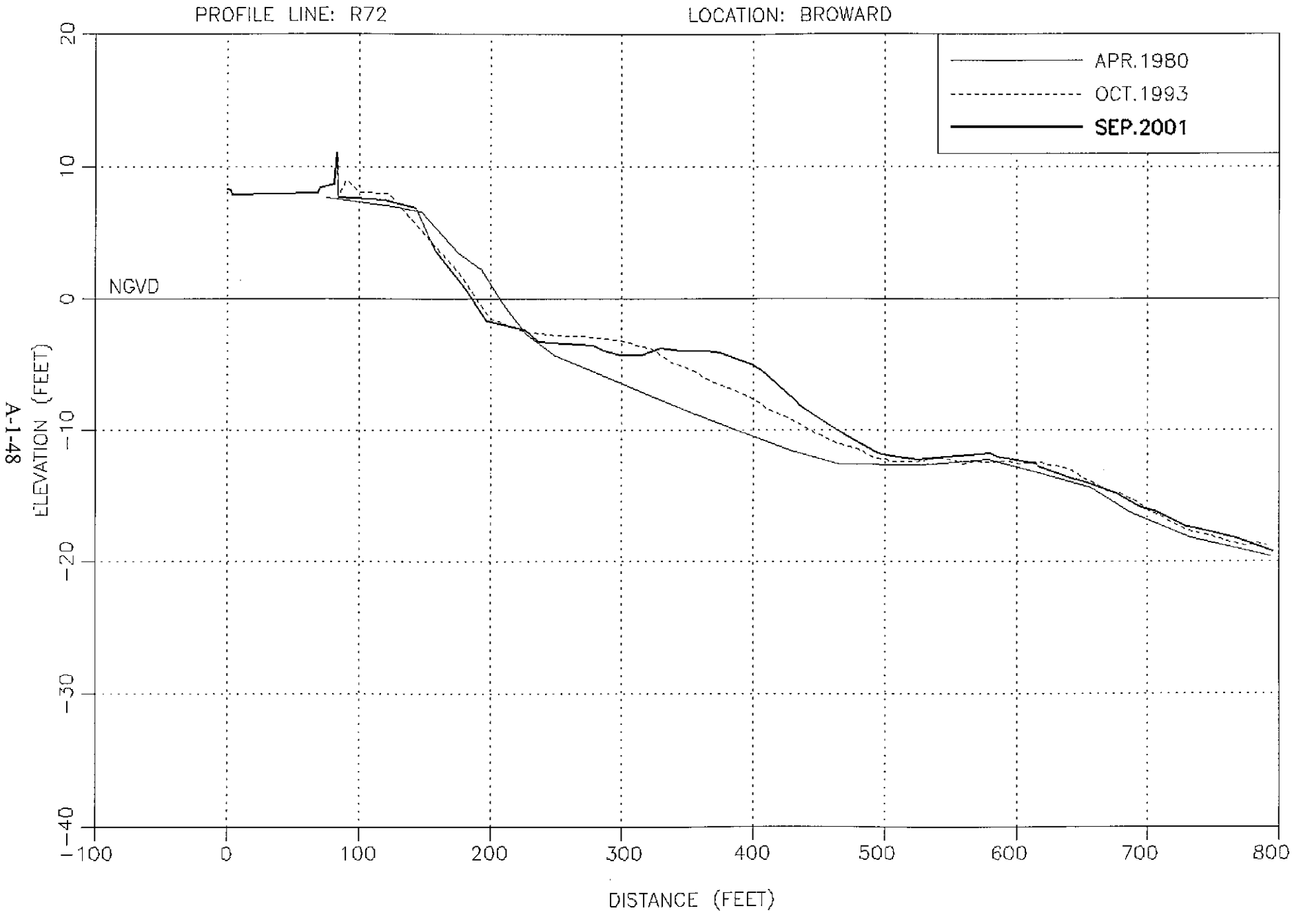
-10
-20
-30
-40
-100
0
100
200
300
400
500
600
700
800


PROFILE LINE: R72
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
20
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-10
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-30
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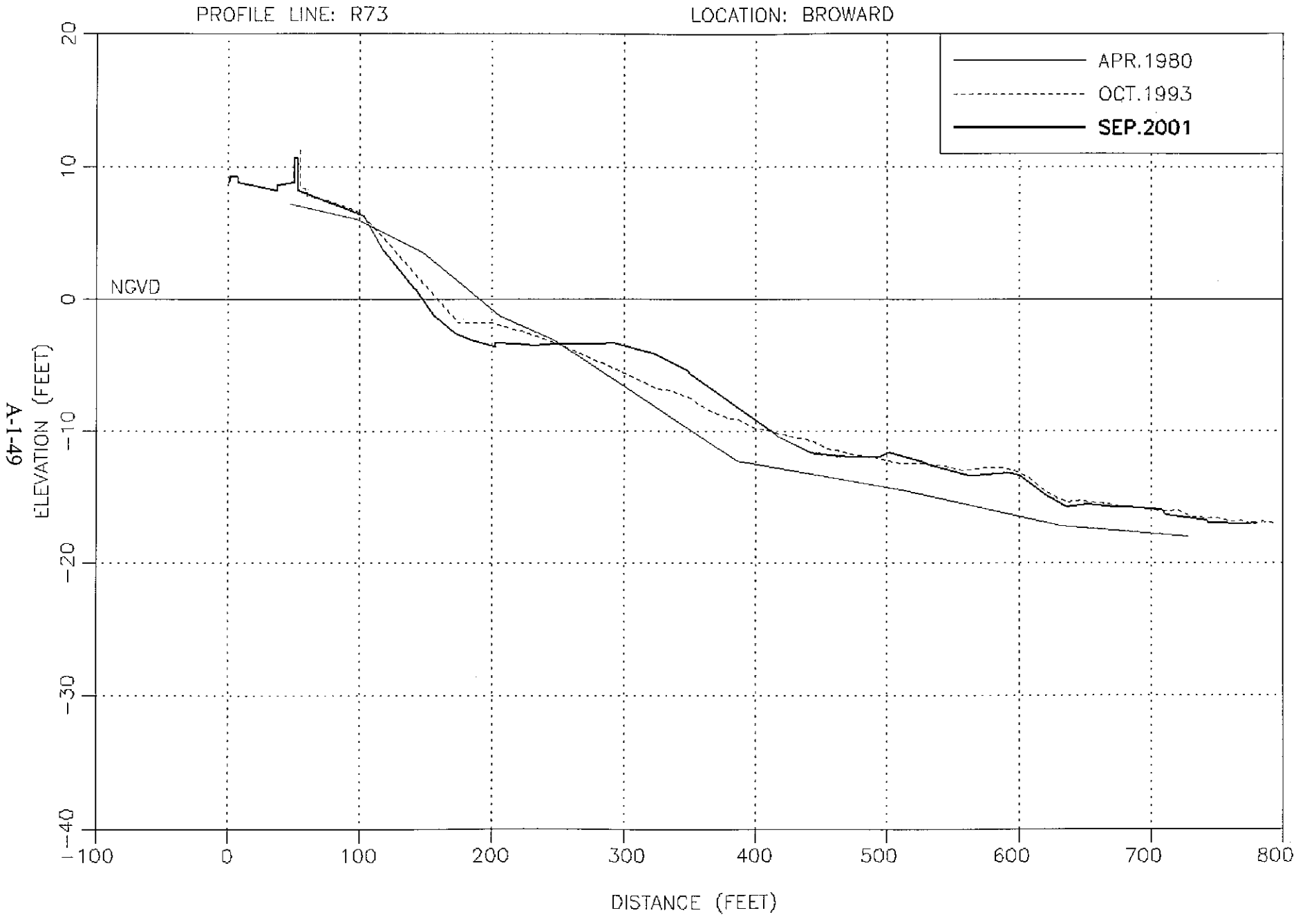
-100
0
100
200
300
400
500
600
700
800
DISTANCE (FEET)


PROFILE LINE: R73
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
ELEVATION (FEET)
DISTANCE (FEET)
20
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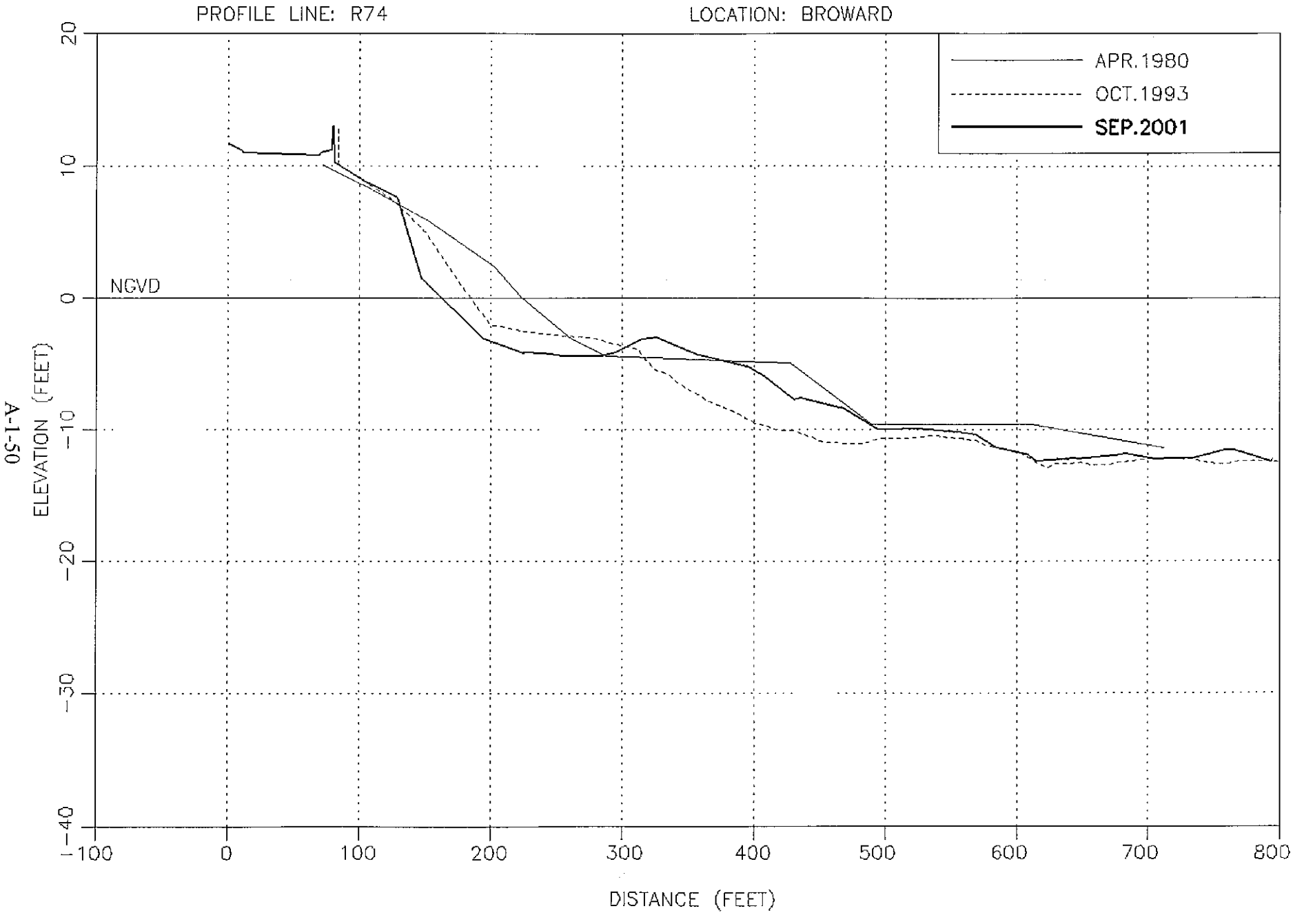
0
-10
-20
-30
-40
-100
0
100
200
300
400
500
600
700
800


PROFILE LINE: R74
LOCATION: BROWARD
APR.1980
OCT.1993
SEP.2001
NGVD
20
10
0
-10
-20
-30
-40
-100
0
100
200
300
400
500
600
700
800
ELEVATION (FEET)
DISTANCE (FEET)
A-1-50

SUB-APPENDIX A-2

DETAILED COST ESTIMATES FOR
RE-EVALUATING THE FEDERAL PROJECT WIDTH

Pompano Beach to Lauderdale by the Sea

ECL/Baseline Extension (ft)	Nourishment Interval (yrs)	Annualized Costs	Primary Benefits (mean)	Net Benefits
75	5	$3,516,000	$24,636,000	$21,120,000
100	5	$3,984,000	$25,258,000	**$21,274,000**
125	5	$4,530,000	$25,618,000	$21,088,000

Sub-Appendix A-2

Re-Evaluation of the Federal Project Optimization Summary

ECL/Baseline Extension (ft)	Nourishment Interval (yrs)	Annualized Costs
75	4	$3,523,000
75	5	**$3,516,000**
75	6	$3,528,000
100	4	$3,991,000
100	5	**$3,984,000**
100	6	$3,995,000
125	4	$4,535,000
125	5	**$4,530,000**
125	6	$4,531,000

Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
75' Added Shoreline Width (ft)
4 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year											
				0	4	8	12	16	20	24	28	32	36	40	44	48
Nourishment	0															
Mobilization/Demobilization		$1,000,000	1	$1,000,000												
Beach Fill		$8.50	2,605,628	$16,936,579												
Beach Tilling (ac)		$300	64.7	$19,396												
Hard Bottom Mitigation (ac)		$300,000	6.5	$1,950,000												
1st Renourishment	4															
Mobilization/Demobilization		$1,000,000	1		$1,000,000											
Beach Fill		$8.50	748,320		$4,864,080											
Beach Tilling (ac)		$300	64.7		$19,396											
Hard Bottom Mitigation (ac)					$0											
2nd Renourishment	8															
Mobilization/Demobilization		$1,000,000	1			$1,000,000										
Beach Fill		$8.50	748,320			$4,864,080										
Beach Tilling (ac)		$300	64.7			$19,396										
Hard Bottom Mitigation (ac)						$0										
3rd Renourishment	12															
Mobilization/Demobilization		$1,000,000	1				$1,000,000									
Beach Fill		$8.50	748,320				$4,864,080									
Beach Tilling (ac)		$300	64.7				$19,396									
Hard Bottom Mitigation (ac)							$0									
4th Renourishment	16															
Mobilization/Demobilization		$1,000,000	1					$1,000,000								
Beach Fill		$8.50	748,320					$4,864,080								
Beach Tilling (ac)		$300	64.7					$19,396								
Hard Bottom Mitigation (ac)								$0								
5th Renourishment	20															
Mobilization/Demobilization		$1,000,000	1						$1,000,000							
Beach Fill		$8.50	748,320						$4,864,080							
Beach Tilling (ac)		$300	64.7						$19,396							
Hard Bottom Mitigation (ac)									$0							
6th Renourishment	24															
Mobilization/Demobilization		$1,000,000	1							$1,000,000						
Beach Fill		$8.50	748,320							$4,864,080						
Beach Tilling (ac)		$300	64.7							$19,396						
Hard Bottom Mitigation (ac)										$0						
7th Renourishment	28															
Mobilization/Demobilization		$1,000,000	1								$1,000,000					
Beach Fill		$8.50	748,320								$4,864,080					
Beach Tilling (ac)		$300	64.7								$19,396					
Hard Bottom Mitigation (ac)											$0					
8th Renourishment	32															
Mobilization/Demobilization		$1,000,000	1									$1,000,000				
Beach Fill		$8.50	748,320									$6,360,720				
Beach Tilling (ac)		$300	64.7									$19,396				
Hard Bottom Mitigation (ac)												$0				
9th Renourishment	36															
Mobilization/Demobilization		$1,000,000	1										$1,000,000			
Beach Fill		$8.50	748,320										$6,360,720			
Beach Tilling (ac)		$300	64.7										$19,396			
Hard Bottom Mitigation (ac)													$0			
10th Renourishment	40															
Mobilization/Demobilization		$1,000,000	1											$1,000,000		
Beach Fill		$8.50	748,320											$6,360,720		
Beach Tilling (ac)		$300	64.7											$19,396		
Hard Bottom Mitigation (ac)														$0		
11th Renourishment	44															
Mobilization/Demobilization		$1,000,000	1												$1,000,000	
Beach Fill		$8.50	748,320												$6,360,720	
Beach Tilling (ac)		$300	64.7												$19,396	
Hard Bottom Mitigation (ac)															$0	
12th Renourishment	48															
Mobilization/Demobilization		$1,000,000	1													$1,000,000
Beach Fill		$8.50	374,160													$3,180,360
Beach Tilling (ac)		$300	55.8													$16,760
Hard Bottom Mitigation (ac)																$0
Subtotal				$19,905,975	$5,883,476	$5,883,476	$5,883,476	$5,883,476	$5,883,476	$5,883,476	$5,883,476	$7,380,116	$7,380,116	$7,380,116	$7,380,116	$4,197,120
Contingency		15%		$2,985,896	$882,521	$882,521	$882,521	$882,521	$882,521	$882,521	$882,521	$1,107,017	$1,107,017	$1,107,017	$1,107,017	$629,568
Subtotal Contract Cost				$22,891,871	$6,765,998	$6,765,998	$6,765,998	$6,765,998	$6,765,998	$6,765,998	$6,765,998	$8,487,134	$8,487,134	$8,487,134	$8,487,134	$4,826,688
		Percentage of Contract Costs														
Nourishment	0															
E&D+S&A		10%	1	$2,289,187												
1st Renourishment	4															
E&D+S&A		20%	1		$1,353,200											
2nd Renourishment	8															
E&D+S&A		20%	1			$1,353,200										
3rd Renourishment	12															
E&D+S&A		20%	1				$1,353,200									
4th Renourishment	16															
E&D+S&A		20%	1					$1,353,200								
5th Renourishment	20															
E&D+S&A		20%	1						$1,353,200							
6th Renourishment	24															
E&D+S&A		20%	1							$1,353,200						
7th Renourishment	28															
E&D+S&A		20%	1								$1,353,200					
8th Renourishment	32															
E&D+S&A		20%	1									$1,697,427				
9th Renourishment	36															
E&D+S&A		20%	1										$1,697,427			
10th Renourishment	40															
E&D+S&A		20%	1											$1,697,427		
11th Renourishment	44															
E&D+S&A		20%	1												$1,697,427	
12th Renourishment	48															
E&D+S&A		20%	1													$965,338
Total Construction Cost				$25,181,058	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$10,184,560	$10,184,560	$10,184,560	$10,184,560	$5,792,025

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year												
	0	4	8	12	16	20	24	28	32	36	40	44	48
Construction Cost	$25,181,058	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$10,184,560	$10,184,560	$10,184,560	$10,184,560	$5,792,025
Interest During Construction	$130,111	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$25,311,169	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$8,119,197	$10,184,560	$10,184,560	$10,184,560	$10,184,560	$5,792,025
Present Worth of Each Construction	$25,311,169	$6,400,918	$5,048,261	$3,978,329	$3,136,388	$2,472,629	$1,949,343	$1,536,609	$1,519,763	$1,198,133	$944,579	$744,659	$333,575
Total Present Worth							$54,572,865						

Average Annual Cost	$2,522,896
Interest Rate	6.125%

12/4/2001 16:07
P:\Broward\530\56 Federal Design Document Revisions\Engineering_Appx_A\Calc\Appendix A 2-Pompano\[A-2 24a A-2 4-complete red plan 75feet x 4] 4 Year

Estimate of Contract and Construction Cost
Pompano Beach/Lauderdale-by-the-Sea
75' Added Shoreline Width (ft)
5 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Nourishment	0												
Mobilization/Demobilization		$1,000,000	1	$1,000,000									
Beach Fill		$6.50	2,792,708	$18,152,599									
Beach Tilling (ac)		$300	69.0	$20,714									
Hard Bottom Mitigation (ac)		$300,000	6.7	$2,010,000									
1st Renourishment	5												
Mobilization/Demobilization		$1,000,000	1		$1,000,000								
Beach Fill		$6.50	935,400		$6,080,100								
Beach Tilling (ac)		$300	69.0		$20,714								
Hard Bottom Mitigation (ac)					$0								
2nd Renourishment	10												
Mobilization/Demobilization		$1,000,000	1			$1,000,000							
Beach Fill		$6.50	935,400			$6,080,100							
Beach Tilling (ac)		$300	69.0			$20,714							
Hard Bottom Mitigation (ac)						$0							
3rd Renourishment	15												
Mobilization/Demobilization		$1,000,000	1				$1,000,000						
Beach Fill		$6.50	935,400				$6,080,100						
Beach Tilling (ac)		$300	69.0				$20,714						
Hard Bottom Mitigation (ac)							$0						
4th Renourishment	20												
Mobilization/Demobilization		$1,000,000	1					$1,000,000					
Beach Fill		$6.50	935,400					$6,080,100					
Beach Tilling (ac)		$300	69.0					$20,714					
Hard Bottom Mitigation (ac)								$0					
5th Renourishment	25												
Mobilization/Demobilization		$1,000,000	1						$1,000,000				
Beach Fill		$8.50	935,400						$8,080,100				
Beach Tilling (ac)		$300	69.0						$20,714				
Hard Bottom Mitigation (ac)									$0				
6th Renourishment	30												
Mobilization/Demobilization		$1,000,000	1							$1,000,000			
Beach Fill		$8.50	935,400							$7,950,900			
Beach Tilling (ac)		$300	69.0							$20,714			
Hard Bottom Mitigation (ac)										$0			
7th Renourishment	35												
Mobilization/Demobilization		$1,000,000	1								$1,000,000		
Beach Fill		$8.50	935,400								$7,950,900		
Beach Tilling (ac)		$300	69.0								$20,714		
Hard Bottom Mitigation (ac)											$0		
8th Renourishment	40												
Mobilization/Demobilization		$1,000,000	1									$1,000,000	
Beach Fill		$8.50	935,400									$7,950,900	
Beach Tilling (ac)		$300	69.0									$20,714	
Hard Bottom Mitigation (ac)												$0	
9th Renourishment	45												
Mobilization/Demobilization		$1,000,000	1										$1,000,000
Beach Fill		$8.50	935,400										$7,950,900
Beach Tilling (ac)		$300	69.0										$20,714
Hard Bottom Mitigation (ac)													$0
Subtotal				$21,183,313	$7,100,814	$7,100,814	$7,100,814	$7,100,814	$7,100,814	$8,971,614	$8,971,614	$8,971,614	$8,971,614
Contingency		15%		$3,177,497	$1,065,122	$1,065,122	$1,065,122	$1,065,122	$1,065,122	$1,345,742	$1,345,742	$1,345,742	$1,345,742
Subtotal Contract Cost				$24,360,810	$8,165,937	$8,165,937	$8,165,937	$8,165,937	$8,165,937	$10,317,357	$10,317,357	$10,317,357	$10,317,357
		Percentage of Contract Costs											
Nourishment	0												
E&D+S&A		10%	1	$2,436,081									
1st Renourishment	5												
E&D+S&A		20%	1		$1,633,187								
2nd Renourishment	10												
E&D+S&A		20%	1			$1,633,187							
3rd Renourishment	15												
E&D+S&A		20%	1				$1,633,187						
4th Renourishment	20												
E&D+S&A		20%	1					$1,633,187					
5th Renourishment	25												
E&D+S&A		20%	1						$1,633,187				
6th Renourishment	30												
E&D+S&A		20%	1							$2,063,471			
7th Renourishment	35												
E&D+S&A		20%	1								$2,063,471		
8th Renourishment	40												
E&D+S&A		20%	1									$2,063,471	
9th Renourishment	45												
E&D+S&A		20%	1										$2,063,471
Total Construction Cost				$26,796,891	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$12,380,828	$12,380,828	$12,380,828	$12,380,828

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Construction Cost	$26,796,891	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$12,380,828	$12,380,828	$12,380,828	$12,380,828
Interest During Construction	$139,148	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$26,936,039	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$9,799,124	$12,380,828	$12,380,828	$12,380,828	$12,380,828
Present Worth of Each Construction	$26,936,039	$7,279,483	$5,407,670	$4,017,184	$2,984,236	$2,216,893	$2,980,744	$1,545,717	$1,148,283	$853,008
Total Present Worth	$54,469,237									

Average Annual Cost	$3,618,264
Interest Rate	5.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
75' Added Shoreline Width (ft)
6 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Nourishment	0											
Mobilization/Demobilization		$1,000,000	1	$1,000,000								
Beach Fill		$6.50	2,979,788	$19,368,619								
Beach Tilling (ac)		$300	73.4	$22,033								
Hard Bottom Mitigation (ac)		$300,000	7.0	$2,100,000								
1st Renourishment	6											
Mobilization/Demobilization		$1,000,000	1		$1,000,000							
Beach Fill		$6.50	1,122,480		$7,296,120							
Beach Tilling (ac)		$300	73.4		$22,033							
Hard Bottom Mitigation (ac)					$0							
2nd Renourishment	12											
Mobilization/Demobilization		$1,000,000	1			$1,000,000						
Beach Fill		$6.50	1,122,480			$7,296,120						
Beach Tilling (ac)		$300	73.4			$22,033						
Hard Bottom Mitigation (ac)						$0						
3rd Renourishment	18											
Mobilization/Demobilization		$1,000,000	1				$1,000,000					
Beach Fill		$6.50	1,122,480				$7,296,120					
Beach Tilling (ac)		$300	73.4				$22,033					
Hard Bottom Mitigation (ac)							$0					
4th Renourishment	24											
Mobilization/Demobilization		$1,000,000	1					$1,000,000				
Beach Fill		$6.50	1,122,480					$7,296,120				
Beach Tilling (ac)		$300	73.4					$22,033				
Hard Bottom Mitigation (ac)								$0				
5th Renourishment	30											
Mobilization/Demobilization		$1,000,000	1						$1,000,000			
Beach Fill		$8.50	1,122,480						$9,541,080			
Beach Tilling (ac)		$300	73.4						$22,033			
Hard Bottom Mitigation (ac)									$0			
6th Renourishment	36											
Mobilization/Demobilization		$1,000,000	1							$1,000,000		
Beach Fill		$8.50	1,122,480							$9,541,080		
Beach Tilling (ac)		$300	73.4							$22,033		
Hard Bottom Mitigation (ac)										$0		
7th Renourishment	42											
Mobilization/Demobilization		$1,000,000	1								$1,000,000	
Beach Fill		$8.50	1,122,480								$9,541,080	
Beach Tilling (ac)		$300	73.4								$22,033	
Hard Bottom Mitigation (ac)											$0	
8th Renourishment	48											
Mobilization/Demobilization		$1,000,000	1									$1,000,000
Beach Fill		$8.50	374,160									$3,180,360
Beach Tilling (ac)		$300	55.9									$16,760
Hard Bottom Mitigation (ac)												$0
Subtotal				$22,490,651	$8,318,153	$8,318,153	$8,318,153	$8,318,153	$10,563,113	$10,563,113	$10,563,113	$4,197,120
Contingency		15%		$3,373,598	$1,247,723	$1,247,723	$1,247,723	$1,247,723	$1,584,467	$1,584,467	$1,584,467	$629,568
Subtotal Contract Cost				$25,864,249	$9,565,875	$9,565,875	$9,565,875	$9,565,875	$12,147,579	$12,147,579	$12,147,579	$4,826,688
		Percentage of Contract Costs										
Nourishment	0											
E&D+S&A		10%	1	$2,586,425								
1st Renourishment	6											
E&D+S&A		20%	1		$1,913,175							
2nd Renourishment	12											
E&D+S&A		20%	1			$1,913,175						
3rd Renourishment	18											
E&D+S&A		20%	1				$1,913,175					
4th Renourishment	24											
E&D+S&A		20%	1					$1,913,175				
5th Renourishment	30											
E&D+S&A		20%	1						$2,429,516			
6th Renourishment	36											
E&D+S&A		20%	1							$2,429,516		
7th Renourishment	42											
E&D+S&A		20%	1								$2,429,516	
8th Renourishment	48											
E&D+S&A		20%	1									$965,338
Total Construction Cost				$28,450,674	$11,479,051	$11,479,051	$11,479,051	$11,479,051	$14,577,095	$14,577,095	$14,577,095	$5,792,025

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Construction Cost	$28,450,674	$11,479,051	$11,479,051	$11,479,051	$11,479,051	$14,577,095	$14,577,095	$14,577,095	$5,792,025
Interest During Construction	$147,735	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$28,598,409	$11,479,051	$11,479,051	$11,479,051	$11,479,051	$14,577,095	$14,577,095	$14,577,095	$5,792,025
Present Worth of Each Construction	$28,598,409	$8,035,257	$5,624,624	$3,937,198	$2,756,012	$2,449,852	$1,714,880	$1,200,404	$333,873
Total Present Worth					$54,650,509				

Average Annual Cost	$3,527,905
Interest Rate	5.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
4 Year Renourishment Interval
Project Life 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	4	8	12	16	20	24	28	32	36	40	44	48
Nourishment	0															
Mobilization/Demobilization		$1,000,000	1	$1,000,000												
Beach Fill		$6.50	3,224,730	$20,960,745												
Beach Tilling (ac)		$300	80.3	$24,104												
Hard Bottom Mitigation (ac)		$300,000	12.0	$3,600,000												
1st Renourishment	4															
Mobilization/Demobilization		$1,000,000	1		$1,000,000											
Beach Fill		$6.50	746,320		$4,864,080											
Beach Tilling (ac)		$300	80.3		$24,104											
Hard Bottom Mitigation (ac)					$0											
2nd Renourishment	8															
Mobilization/Demobilization		$1,000,000	1			$1,000,000										
Beach Fill		$6.50	748,320			$4,864,080										
Beach Tilling (ac)		$300	80.3			$24,104										
Hard Bottom Mitigation (ac)						$0										
3rd Renourishment	12															
Mobilization/Demobilization		$1,000,000	1				$1,000,000									
Beach Fill		$6.50	748,320				$4,864,080									
Beach Tilling (ac)		$300	80.3				$24,104									
Hard Bottom Mitigation (ac)							$0									
4th Renourishment	16															
Mobilization/Demobilization		$1,000,000	1					$1,000,000								
Beach Fill		$6.50	748,320					$4,864,080								
Beach Tilling (ac)		$300	80.3					$24,104								
Hard Bottom Mitigation (ac)								$0								
5th Renourishment	20															
Mobilization/Demobilization		$1,000,000	1						$1,000,000							
Beach Fill		$6.50	748,320						$4,864,080							
Beach Tilling (ac)		$300	80.3						$24,104							
Hard Bottom Mitigation (ac)									$0							
6th Renourishment	24															
Mobilization/Demobilization		$1,000,000	1							$1,000,000						
Beach Fill		$6.50	748,320							$4,864,080						
Beach Tilling (ac)		$300	80.3							$24,104						
Hard Bottom Mitigation (ac)										$0						
7th Renourishment	28															
Mobilization/Demobilization		$1,000,000	1								$1,000,000					
Beach Fill		$6.50	748,320								$4,864,080					
Beach Tilling (ac)		$300	80.3								$24,104					
Hard Bottom Mitigation (ac)											$0					
8th Renourishment	32															
Mobilization/Demobilization		$1,000,000	1									$1,000,000				
Beach Fill		$8.50	748,320									$6,360,720				
Beach Tilling (ac)		$300	80.3									$24,104				
Hard Bottom Mitigation (ac)												$0				
9th Renourishment	36															
Mobilization/Demobilization		$1,000,000	1										$1,000,000			
Beach Fill		$8.50	748,320										$6,360,720			
Beach Tilling (ac)		$300	80.3										$24,104			
Hard Bottom Mitigation (ac)													$0			
10th Renourishment	40															
Mobilization/Demobilization		$1,000,000	1											$1,000,000		
Beach Fill		$8.50	748,320											$6,360,720		
Beach Tilling (ac)		$300	80.3											$24,104		
Hard Bottom Mitigation (ac)														$0		
11th Renourishment	44															
Mobilization/Demobilization		$1,000,000	1												$1,000,000	
Beach Fill		$8.50	748,320												$6,360,720	
Beach Tilling (ac)		$300	80.3												$24,104	
Hard Bottom Mitigation (ac)															$0	
12th Renourishment	48															
Mobilization/Demobilization		$1,000,000	1													$1,000,000
Beach Fill		$8.50	374,160													$3,180,360
Beach Tilling (ac)		$300	71.6													$21,468
Hard Bottom Mitigation (ac)																$0
Subtotal				$25,584,849	$5,888,184	$5,888,184	$5,888,184	$5,888,184	$5,888,184	$5,888,184	$5,888,184	$7,384,824	$7,384,824	$7,384,824	$7,384,824	$4,201,828
Contingency		15%		$3,837,727	$883,228	$883,228	$883,228	$883,228	$883,228	$883,228	$883,228	$1,107,724	$1,107,724	$1,107,724	$1,107,724	$630,274
Subtotal Contract Cost				$29,422,576	$6,771,412	$6,771,412	$6,771,412	$6,771,412	$6,771,412	$6,771,412	$6,771,412	$8,492,548	$8,492,548	$8,492,548	$8,492,548	$4,832,102
		Percentage of Contract Costs														
Nourishment	0															
E&D+S&A		10%	1	$2,942,258												
1st Renourishment	4															
E&D+S&A		20%	1		$1,354,282											
2nd Renourishment	8															
E&D+S&A		20%	1			$1,354,282										
3rd Renourishment	12															
E&D+S&A		20%	1				$1,354,282									
4th Renourishment	16															
E&D+S&A		20%	1					$1,354,282								
5th Renourishment	20															
E&D+S&A		20%	1						$1,354,282							
6th Renourishment	24															
E&D+S&A		20%	1							$1,354,282						
7th Renourishment	28															
E&D+S&A		20%	1								$1,354,282					
8th Renourishment	32															
E&D+S&A		20%	1									$1,698,510				
9th Renourishment	36															
E&D+S&A		20%	1										$1,698,510			
10th Renourishment	40															
E&D+S&A		20%	1											$1,698,510		
11th Renourishment	44															
E&D+S&A		20%	1												$1,698,510	
12th Renourishment	48															
E&D+S&A		20%	1													$966,420
Total Construction Cost				$32,364,834	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$10,191,057	$10,191,057	$10,191,057	$10,191,057	$5,798,522

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	4	8	12	16	20	24	28	32	36	40	44	48
Construction Cost	$32,364,834	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$10,191,057	$10,191,057	$10,191,057	$10,191,057	$5,798,522
Interest During Construction	$168,895	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$32,533,729	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$8,125,694	$10,191,057	$10,191,057	$10,191,057	$10,191,057	$5,798,522
Present Worth of Each Construction	$32,533,729	$6,406,340	$5,050,319	$3,981,512	$3,136,896	$2,474,608	$1,950,903	$1,538,030	$1,520,732	$1,198,897	$945,173	$745,144	$334,247
Total Present Worth							$61,818,232						

Average Annual Cost	$3,990,613
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
5 Year Renourishment Interval
Project Life 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Nourishment	0												
Mobilization/Demobilization		$1,000,000	1	$1,000,000									
Beach Fill		$6.50	3,411,810	$22,176,765									
Beach Tilling (ac)		$300	84.7	$25,422									
Hard Bottom Mitigation (ac)		$300,000	12.2	$3,660,000									
1st Renourishment	5												
Mobilization/Demobilization		$1,000,000	1		$1,000,000								
Beach Fill		$6.50	935,400		$6,080,100								
Beach Tilling (ac)		$300	84.7		$25,422								
Hard Bottom Mitigation (ac)					$0								
2nd Renourishment	10												
Mobilization/Demobilization		$1,000,000	1			$1,000,000							
Beach Fill		$6.50	935,400			$6,080,100							
Beach Tilling (ac)		$300	84.7			$25,422							
Hard Bottom Mitigation (ac)						$0							
3rd Renourishment	15												
Mobilization/Demobilization		$1,000,000	1				$1,000,000						
Beach Fill		$6.50	935,400				$6,080,100						
Beach Tilling (ac)		$300	84.7				$25,422						
Hard Bottom Mitigation (ac)							$0						
4th Renourishment	20												
Mobilization/Demobilization		$1,000,000	1					$1,000,000					
Beach Fill		$6.50	935,400					$6,080,100					
Beach Tilling (ac)		$300	84.7					$25,422					
Hard Bottom Mitigation (ac)								$0					
5th Renourishment	25												
Mobilization/Demobilization		$1,000,000	1						$1,000,000				
Beach Fill		$6.50	935,400						$6,080,100				
Beach Tilling (ac)		$300	84.7						$25,422				
Hard Bottom Mitigation (ac)									$0				
6th Renourishment	30												
Mobilization/Demobilization		$1,000,000	1							$1,000,000			
Beach Fill		$8.50	935,400							$7,950,900			
Beach Tilling (ac)		$300	84.7							$25,422			
Hard Bottom Mitigation (ac)										$0			
7th Renourishment	35												
Mobilization/Demobilization		$1,000,000	1								$1,000,000		
Beach Fill		$8.50	935,400								$7,950,900		
Beach Tilling (ac)		$300	84.7								$25,422		
Hard Bottom Mitigation (ac)											$0		
8th Renourishment	40												
Mobilization/Demobilization		$1,000,000	1									$1,000,000	
Beach Fill		$8.50	935,400									$7,950,900	
Beach Tilling (ac)		$300	84.7									$25,422	
Hard Bottom Mitigation (ac)												$0	
9th Renourishment	45												
Mobilization/Demobilization		$1,000,000	1										$1,000,000
Beach Fill		$8.50	935,400										$7,950,900
Beach Tilling (ac)		$300	84.7										$25,422
Hard Bottom Mitigation (ac)													$0
Subtotal				$26,862,187	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$7,105,522	$8,976,322	$8,976,322	$8,976,322	$8,976,322
Contingency		15%		$4,029,328	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,065,828	$1,346,448	$1,346,448	$1,346,448	$1,346,448
Subtotal Contract Cos:				$30,891,515	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$8,171,351	$10,322,771	$10,322,771	$10,322,771	$10,322,771
		Percentage of Contract Costs											
Nourishment	0												
E&D+S&A		10%	1	$3,089,152									
1st Renourishment	5												
E&D+S&A		20%	1		$1,634,270								
2nd Renourishment	10												
E&D+S&A		20%	1			$1,634,270							
3rd Renourishment	15												
E&D+S&A		20%	1				$1,634,270						
4th Renourishment	20												
E&D+S&A		20%	1					$1,634,270					
5th Renourishment	25												
E&D+S&A		20%	1						$1,634,270				
6th Renourishment	30												
E&D+S&A		20%	1							$2,064,554			
7th Renourishment	35												
E&D+S&A		20%	1								$2,064,554		
8th Renourishment	40												
E&D+S&A		20%	1									$2,064,554	
9th Renourishment	45												
E&D+S&A		20%	1										$2,064,554
Total Construction Cost				$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Construction Cost	$33,980,667	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325
Interest During Construction	$178,208	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$34,158,874	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$9,805,621	$12,387,325	$12,387,325	$12,387,325	$12,387,325
Present Worth of Each Construction	$34,158,874	$7,284,279	$5,411,256	$4,019,847	$2,988,215	$2,218,362	$2,081,836	$1,546,528	$1,148,886	$853,455
Total Present Worth	$61,709,519									

Average Annual Cost	$3,693,595
Interest Rate	5.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
6 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Nourishment	0											
Mobilization/Demobilization		$1,000,000	1	$1,000,000								
Beach Fill		$6.50	3,598,890	$23,392,785								
Beach Tilling (ac)		$300	89.1	$26,740								
Hard Bottom Mitigation (ac)		$300,000	12.5	$3,750,000								
1st Renourishment	6											
Mobilization/Demobilization		$1,000,000	1		$1,000,000							
Beach Fill		$6.50	1,122,480		$7,296,120							
Beach Tilling (ac)		$300	89.1		$26,740							
Hard Bottom Mitigation (ac)					$0							
2nd Renourishment	12											
Mobilization/Demobilization		$1,000,000	1			$1,000,000						
Beach Fill		$6.50	1,122,480			$7,296,120						
Beach Tilling (ac)		$300	89.1			$26,740						
Hard Bottom Mitigation (ac)						$0						
3rd Renourishment	18											
Mobilization/Demobilization		$1,000,000	1				$1,000,000					
Beach Fill		$6.50	1,122,480				$7,296,120					
Beach Tilling (ac)		$300	89.1				$26,740					
Hard Bottom Mitigation (ac)							$0					
4th Renourishment	24											
Mobilization/Demobilization		$1,000,000	1					$1,000,000				
Beach Fill		$6.50	1,122,480					$7,296,120				
Beach Tilling (ac)		$300	89.1					$26,740				
Hard Bottom Mitigation (ac)								$0				
5th Renourishment	30											
Mobilization/Demobilization		$1,000,000	1						$1,000,000			
Beach Fill		$8.50	1,122,480						$9,541,080			
Beach Tilling (ac)		$300	89.1						$26,740			
Hard Bottom Mitigation (ac)									$0			
6th Renourishment	36											
Mobilization/Demobilization		$1,000,000	1							$1,000,000		
Beach Fill		$8.50	1,122,480							$9,541,080		
Beach Tilling (ac)		$300	89.1							$26,740		
Hard Bottom Mitigation (ac)										$0		
7th Renourishment	42											
Mobilization/Demobilization		$1,000,000	1								$1,000,000	
Beach Fill		$8.50	1,122,480								$9,541,080	
Beach Tilling (ac)		$300	89.1								$26,740	
Hard Bottom Mitigation (ac)											$0	
8th Renourishment	48											
Mobilization/Demobilization		$1,000,000	1									$1,000,000
Beach Fill		$8.50	374,160									$3,180,360
Beach Tilling (ac)		$300	71.6									$21,468
Hard Bottom Mitigation (ac)												$0
Subtotal				$28,169,525	$8,322,860	$8,322,860	$8,322,860	$8,322,860	$10,567,820	$10,567,820	$10,567,820	$4,201,828
Contingency		15%		$4,225,429	$1,248,429	$1,248,429	$1,248,429	$1,248,429	$1,585,173	$1,585,173	$1,585,173	$630,274
Subtotal Contract Cost				$32,394,954	$9,571,289	$9,571,289	$9,571,289	$9,571,289	$12,152,993	$12,152,993	$12,152,993	$4,832,102
		Percentage of Contract Costs										
Nourishment	0											
E&D+S&A		10%	1	$3,239,495								
1st Renourishment	6											
E&D+S&A		20%	1		$1,914,258							
2nd Renourishment	12											
E&D+S&A		20%	1			$1,914,258						
3rd Renourishment	18											
E&D+S&A		20%	1				$1,914,258					
4th Renourishment	24											
E&D+S&A		20%	1					$1,914,258				
5th Renourishment	30											
E&D+S&A		20%	1						$2,430,599			
6th Renourishment	36											
E&D+S&A		20%	1							$2,430,599		
7th Renourishment	42											
E&D+S&A		20%	1								$2,430,599	
8th Renourishment	48											
E&D+S&A		20%	1									$966,420
Total Construction Cost				$35,634,450	$11,485,547	$11,485,547	$11,485,547	$11,485,547	$14,583,592	$14,583,592	$14,583,592	$5,798,522

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Construction Cost	$35,634,450	$11,485,547	$11,485,547	$11,485,547	$11,485,547	$14,583,592	$14,583,592	$14,583,592	$5,798,522
Interest During Construction	$186,881	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$35,821,330	$11,485,547	$11,485,547	$11,485,547	$11,485,547	$14,583,592	$14,583,592	$14,583,592	$5,798,522
Present Worth of Each Construction	$35,821,330	$8,038,804	$5,627,808	$3,939,427	$2,757,572	$2,450,944	$1,715,644	$1,200,939	$334,247
Total Present Worth					$61,887,715				

Average Annual Cost	$3,995,099
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Pompano Beach-Lauderdale-by-the-Sea
125' Added Shoreline Width (ft)
4 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	4	8	12	16	20	24	28	32	36	40	44	48
Nourishment	0															
Mobilization/Demobilization		$1,000,000	1	$1,000,000												
Beach Fill		$6.50	3,843,633	$24,984,911												
Beach Tilling (ac)		$300	96.0	$28,812												
Hard Bottom Mitigation (ac)		$300,000	20.6	$6,180,000												
1st Renourishment	4															
Mobilization/Demobilization		$1,000,000	1		$1,000,000											
Beach Fill		$6.50	748,320		$4,864,080											
Beach Tilling (ac)		$300	96.0		$28,812											
Hard Bottom Mitigation (ac)					$0											
2nd Renourishment	8															
Mobilization/Demobilization		$1,000,000	1			$1,000,000										
Beach Fill		$6.50	748,320			$4,864,080										
Beach Tilling (ac)		$300	96.0			$28,812										
Hard Bottom Mitigation (ac)						$0										
3rd Renourishment	12															
Mobilization/Demobilization		$1,000,000	1				$1,000,000									
Beach Fill		$6.50	748,320				$4,864,080									
Beach Tilling (ac)		$300	96.0				$28,812									
Hard Bottom Mitigation (ac)							$0									
4th Renourishment	16															
Mobilization/Demobilization		$1,000,000	1					$1,000,000								
Beach Fill		$6.50	748,320					$4,864,080								
Beach Tilling (ac)		$300	96.0					$28,812								
Hard Bottom Mitigation (ac)								$0								
5th Renourishment	20															
Mobilization/Demobilization		$1,000,000	1						$1,000,000							
Beach Fill		$6.50	748,320						$4,864,080							
Beach Tilling (ac)		$300	96.0						$28,812							
Hard Bottom Mitigation (ac)									$0							
6th Renourishment	24															
Mobilization/Demobilization		$1,000,000	1							$1,000,000						
Beach Fill		$6.50	748,320							$4,864,080						
Beach Tilling (ac)		$300	96.0							$28,812						
Hard Bottom Mitigation (ac)										$0						
7th Renourishment	28															
Mobilization/Demobilization		$1,000,000	1								$1,000,000					
Beach Fill		$6.50	748,320								$4,864,080					
Beach Tilling (ac)		$300	96.0								$28,812					
Hard Bottom Mitigation (ac)											$0					
8th Renourishment	32															
Mobilization/Demobilization		$1,000,000	1									$1,000,000				
Beach Fill		$8.50	748,320									$6,360,720				
Beach Tilling (ac)		$300	96.0									$28,812				
Hard Bottom Mitigation (ac)												$0				
9th Renourishment	36															
Mobilization/Demobilization		$1,000,000	1										$1,000,000			
Beach Fill		$8.50	748,320										$6,360,720			
Beach Tilling (ac)		$300	96.0										$28,812			
Hard Bottom Mitigation (ac)													$0			
10th Renourishment	40															
Mobilization/Demobilization		$1,000,000	1											$1,000,000		
Beach Fill		$8.50	748,320											$6,360,720		
Beach Tilling (ac)		$300	96.0											$28,812		
Hard Bottom Mitigation (ac)														$0		
11th Renourishment	44															
Mobilization/Demobilization		$1,000,000	1												$1,000,000	
Beach Fill		$8.50	748,320												$6,360,720	
Beach Tilling (ac)		$300	96.0												$28,812	
Hard Bottom Mitigation (ac)															$0	
12th Renourishment	48															
Mobilization/Demobilization		$1,000,000	1													$1,000,000
Beach Fill		$8.50	374,160													$3,180,360
Beach Tilling (ac)		$300	87.3													$26,175
Hard Bottom Mitigation (ac)																$0
Subtotal				$32,193,723	$5,892,892	$5,892,892	$5,892,892	$5,892,892	$5,892,892	$5,892,892	$5,892,892	$7,389,532	$7,389,532	$7,389,532	$7,389,532	$4,206,535
Contingency		15%		$4,829,058	$883,934	$883,934	$883,934	$883,934	$883,934	$883,934	$883,934	$1,108,430	$1,108,430	$1,108,430	$1,108,430	$630,980
Subtotal Contract Cost				$37,022,782	$6,776,826	$6,776,826	$6,776,826	$6,776,826	$6,776,826	$6,776,826	$6,776,826	$8,497,962	$8,497,962	$8,497,962	$8,497,962	$4,837,516
		Percentage of Contract Costs														
Nourishment	0															
E&D+S&A		10%	1	$3,702,278												
1st Renourishment	4															
E&D+S&A		20%	1		$1,355,365											
2nd Renourishment	8															
E&D+S&A		20%	1			$1,355,365										
3rd Renourishment	12															
E&D+S&A		20%	1				$1,355,365									
4th Renourishment	16															
E&D+S&A		20%	1					$1,355,365								
5th Renourishment	20															
E&D+S&A		20%	1						$1,355,365							
6th Renourishment	24															
E&D+S&A		20%	1							$1,355,365						
7th Renourishment	28															
E&D+S&A		20%	1								$1,355,365					
8th Renourishment	32															
E&D+S&A		20%	1									$1,699,592				
9th Renourishment	36															
E&D+S&A		20%	1										$1,699,592			
10th Renourishment	40															
E&D+S&A		20%	1											$1,699,592		
11th Renourishment	44															
E&D+S&A		20%	1												$1,699,592	
12th Renourishment	48															
E&D+S&A		20%	1													$967,503
Total Construction Cost				$40,725,060	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$10,197,554	$10,197,554	$10,197,554	$10,197,554	$5,805,019

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	4	8	12	16	20	24	28	32	36	40	44	48
Construction Cost	$40,725,060	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$10,197,554	$10,197,554	$10,197,554	$10,197,554	$5,805,019
Interest During Construction	$214,639	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$40,939,698	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$8,132,191	$10,197,554	$10,197,554	$10,197,554	$10,197,554	$5,805,019
Present Worth of Each Construction	$40,939,698	$6,411,162	$5,054,357	$3,984,695	$3,141,406	$2,476,586	$1,952,462	$1,539,260	$1,521,702	$1,199,661	$945,776	$745,619	$334,622
Total Present Worth							$70,247,008						

Average Annual Cost	$4,534,724
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
125' Added Shoreline Width (ft)
5 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Nourishment	0												
Mobilization/Demobilization		$1,000,000	1	$1,000,000									
Beach Fill		$6.50	4,030,913	$26,200,931									
Beach Tilling (ac)		$300	100.4	$30,130									
Hard Bottom Mitigation (ac)		$300,000	20.9	$6,270,000									
1st Renourishment	5												
Mobilization/Demobilization		$1,000,000	1		$1,000,000								
Beach Fill		$6.50	935,400		$6,080,100								
Beach Tilling (ac)		$300	100.4		$30,130								
Hard Bottom Mitigation (ac)					$0								
2nd Renourishment	10												
Mobilization/Demobilization		$1,000,000	1			$1,000,000							
Beach Fill		$6.50	935,400			$6,080,100							
Beach Tilling (ac)		$300	100.4			$30,130							
Hard Bottom Mitigation (ac)						$0							
3rd Renourishment	15												
Mobilization/Demobilization		$1,000,000	1				$1,000,000						
Beach Fill		$6.50	935,400				$6,080,100						
Beach Tilling (ac)		$300	100.4				$30,130						
Hard Bottom Mitigation (ac)							$0						
4th Renourishment	20												
Mobilization/Demobilization		$1,000,000	1					$1,000,000					
Beach Fill		$6.50	935,400					$6,080,100					
Beach Tilling (ac)		$300	100.4					$30,130					
Hard Bottom Mitigation (ac)								$0					
5th Renourishment	25												
Mobilization/Demobilization		$1,000,000	1						$1,000,000				
Beach Fill		$6.50	935,400						$6,080,100				
Beach Tilling (ac)		$300	100.4						$30,130				
Hard Bottom Mitigation (ac)									$0				
6th Renourishment	30												
Mobilization/Demobilization		$1,000,000	1							$1,000,000			
Beach Fill		$6.50	935,400							$7,950,900			
Beach Tilling (ac)		$300	100.4							$30,130			
Hard Bottom Mitigation (ac)										$0			
7th Renourishment	35												
Mobilization/Demobilization		$1,000,000	1								$1,000,000		
Beach Fill		$6.50	935,400								$7,950,900		
Beach Tilling (ac)		$300	100.4								$30,130		
Hard Bottom Mitigation (ac)											$0		
8th Renourishment	40												
Mobilization/Demobilization		$1,000,000	1									$1,000,000	
Beach Fill		$6.50	935,400									$7,950,900	
Beach Tilling (ac)		$300	100.4									$30,130	
Hard Bottom Mitigation (ac)												$0	
9th Renourishment	45												
Mobilization/Demobilization		$1,000,000	1										$1,000,000
Beach Fill		$6.50	935,400										$7,950,900
Beach Tilling (ac)		$300	100.4										$30,130
Hard Bottom Mitigation (ac)													$0
Subtotal				$33,501,061	$7,110,230	$7,110,230	$7,110,230	$7,110,230	$7,110,230	$8,981,030	$8,981,030	$8,981,030	$8,981,030
Contingency		15%		$5,025,159	$1,066,535	$1,066,535	$1,066,535	$1,066,535	$1,066,535	$1,347,155	$1,347,155	$1,347,155	$1,347,155
Subtotal Contract Cost				$38,526,220	$8,176,765	$8,176,765	$8,176,765	$8,176,765	$8,176,765	$10,328,185	$10,328,185	$10,328,185	$10,328,185
		Percentage of Contract Costs											
Nourishment	0												
E&D+S&A		10%	1	$3,852,622									
1st Renourishment	5												
E&D+S&A		20%	1		$1,635,353								
2nd Renourishment	10												
E&D+S&A		20%	1			$1,635,353							
3rd Renourishment	15												
E&D+S&A		20%	1				$1,635,353						
4th Renourishment	20												
E&D+S&A		20%	1					$1,635,353					
5th Renourishment	25												
E&D+S&A		20%	1						$1,635,353				
6th Renourishment	30												
E&D+S&A		20%	1							$2,065,637			
7th Renourishment	35												
E&D+S&A		20%	1								$2,065,637		
8th Renourishment	40												
E&D+S&A		20%	1									$2,065,637	
9th Renourishment	45												
E&D+S&A		20%	1										$2,065,637
Total Construction Cost				$42,378,843	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$12,393,821	$12,393,821	$12,393,821	$12,393,821

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	5	10	15	20	25	30	35	40	45
Construction Cost	$42,378,843	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$12,393,821	$12,393,821	$12,393,821	$12,393,821
Interest During Construction	$224,464	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$42,603,306	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$9,812,117	$12,393,821	$12,393,821	$12,393,821	$12,393,821
Present Worth of Each Construction	$42,603,306	$7,289,105	$5,414,841	$4,022,511	$2,988,193	$2,219,832	$2,082,927	$1,547,340	$1,149,469	$853,903
Total Present Worth	$70,171,427									

Average Annual Cost	$4,529,845
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Pompano Beach/Lauderdale-by-the-Sea
125' Added Shoreline Width (ft)
6 Year Renourishment Interval
Project Life: 50 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Nourishment	0											
Mobilization/Demobilization		$1,000,000	1	$1,000,000								
Beach Fill		$6.50	4,217,993	$27,416,951								
Beach Tilling (ac)		$300	104.8	$31,448								
Hard Bottom Mitigation (ac)		$300,000	20.8	$6,240,000								
1st Renourishment	6											
Mobilization/Demobilization		$1,000,000	1		$1,000,000							
Beach Fill		$6.50	1,122,480		$7,296,120							
Beach Tilling (ac)		$300	104.8		$31,448							
Hard Bottom Mitigation (ac)					$0							
2nd Renourishment	12											
Mobilization/Demobilization		$1,000,000	1			$1,000,000						
Beach Fill		$6.50	1,122,480			$7,296,120						
Beach Tilling (ac)		$300	104.8			$31,448						
Hard Bottom Mitigation (ac)						$0						
3rd Renourishment	18											
Mobilization/Demobilization		$1,000,000	1				$1,000,000					
Beach Fill		$6.50	1,122,480				$7,296,120					
Beach Tilling (ac)		$300	104.8				$31,448					
Hard Bottom Mitigation (ac)							$0					
4th Renourishment	24											
Mobilization/Demobilization		$1,000,000	1					$1,000,000				
Beach Fill		$6.50	1,122,480					$7,296,120				
Beach Tilling (ac)		$300	104.8					$31,448				
Hard Bottom Mitigation (ac)								$0				
5th Renourishment	30											
Mobilization/Demobilization		$1,000,000	1						$1,000,000			
Beach Fill		$8.50	1,122,480						$9,541,080			
Beach Tilling (ac)		$300	104.8						$31,448			
Hard Bottom Mitigation (ac)									$0			
6th Renourishment	36											
Mobilization/Demobilization		$1,000,000	1							$1,000,000		
Beach Fill		$8.50	1,122,480							$9,541,080		
Beach Tilling (ac)		$300	104.8							$31,448		
Hard Bottom Mitigation (ac)										$0		
7th Renourishment	42											
Mobilization/Demobilization		$1,000,000	1								$1,000,000	
Beach Fill		$8.50	1,122,480								$9,541,080	
Beach Tilling (ac)		$300	104.8								$31,448	
Hard Bottom Mitigation (ac)											$0	
8th Renourishment	48											
Mobilization/Demobilization		$1,000,000	1									$1,000,000
Beach Fill		$8.50	374,160									$3,180,360
Beach Tilling (ac)		$300	87.3									$26,175
Hard Bottom Mitigation (ac)												$0
Subtotal				$34,688,399	$8,327,568	$8,327,568	$8,327,568	$8,327,568	$10,572,528	$10,572,528	$10,572,528	$4,206,535
Contingency		15%		$5,203,260	$1,249,135	$1,249,135	$1,249,135	$1,249,135	$1,585,879	$1,585,879	$1,585,879	$630,980
Subtotal Contract Cost				$39,891,659	$9,576,703	$9,576,703	$9,576,703	$9,576,703	$12,158,407	$12,158,407	$12,158,407	$4,837,516
		Percentage of Contract Costs										
Nourishment	0											
E&D+S&A		10%	1	$3,989,166								
1st Renourishment	6											
E&D+S&A		20%	1		$1,915,341							
2nd Renourishment	12											
E&D+S&A		20%	1			$1,915,341						
3rd Renourishment	18											
E&D+S&A		20%	1				$1,916,341					
4th Renourishment	24											
E&D+S&A		20%	1					$1,915,341				
5th Renourishment	30											
E&D+S&A		20%	1						$2,431,681			
6th Renourishment	36											
E&D+S&A		20%	1							$2,431,681		
7th Renourishment	42											
E&D+S&A		20%	1								$2,431,681	
8th Renourishment	48											
E&D+S&A		20%	1									$967,503
Total Construction Cost				$43,880,825	$11,492,044	$11,492,044	$11,492,044	$11,492,044	$14,590,089	$14,590,089	$14,590,089	$5,805,019

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 0	6	12	18	24	30	36	42	48
Construction Cost	$43,880,825	$11,492,044	$11,492,044	$11,492,044	$11,492,044	$14,590,089	$14,590,089	$14,590,089	$5,805,019
Interest During Construction	$233,574	$0	$0	$0	$0	$0	$0	$0	$0
Total Investment Cost	$44,114,399	$11,492,044	$11,492,044	$11,492,044	$11,492,044	$14,590,089	$14,590,089	$14,590,089	$5,805,019
Present Worth of Each Construction	$44,114,399	$8,044,352	$5,630,991	$3,941,655	$2,759,132	$2,452,036	$1,716,408	$1,201,474	$334,622
Total Present Worth					$70,195,069				

Average Annual Cost	$4,531,371
Interest Rate	6.125%

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SUB-APPENDIX A-3

DETAILED COST ESTIMATES FOR EVALUATION OF THE WIDTH OF THE MODIFICATION TO THE FEDERAL PROJECT

Sub-Apendix A-3

Modification to the Federal Project
Optimization Summary

Baseline Extension (ft)	South Project Limit	Nourishment Interval (yrs)	Annualized Costs
1	R-74	11	$1,018,000
1	R-74	12	**$1,016,000**
1	R-74	13	$1,017,000
20	R-74	11	$1,455,000
20	R-74	12	**$1,455,000**
20	R-74	13	$1,457,000
25	R-74	10	$1,575,000
25	R-74	11	**$1,574,000**
25	R-74	12	$1,574,000
50	R-74	9	$2,203,000
50	R-74	10	**$2,202,000**
50	R-74	11	$2,204,000

Fort Lauderdale

Baseline Extension (ft)	South Project Limit	Nourishment Interval (yrs)	Annualized Costs	Primary Benefits (mean)	Net Benefits
1	R-74	12	$1,016,000	$2,007,000	$991,000
20	R-74	12	$1,455,000	$2,773,000	$1,318,000
25	R-74	11	$1,574,000	$2,923,000	**$1,349,000**
50	R-74	10	$2,202,000	$3,419,000	$1,217,000

Estimate of Contract and Construction Costs
Ft Lauderdale
1' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	485,078	$4,365,699	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	0.5	$145	$145
Hard Bottom Mitigation (ac)		$300,000	4.0	$1,188,940	
Subtotal				$6,554,784	$3,599,792
Contingency		15%		$983,218	$539,969
Subtotal Contract Cost				$7,538,002	$4,139,761
Nourishment					
E&D+S&A		10%	1	$753,800	
1st Renourishment					
E&D+S&A		20%	1		$827,952
Total Construction Cost				$8,291,802	$4,967,713

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$8,291,802	$4,967,713
Interest During Construction	$41,384	$0
Total Investment Cost	$8,333,185	$4,967,713
Present Worth of Each Construction	$8,333,185	$2,583,222
Total Present Worth	$10,916,407	

Average Annual Cost	$1,017,686
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
1' Added Shoreline Width (ft) to R-74
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	503,965	$4,535,685	
	12	$9.00	269,962		$2,429,660
Beach Tilling (ac)		$300	0.5	$145	$145
Hard Bottom Mitigation (ac)		$300,000	4.0	$1,214,668	
Subtotal				$6,750,499	$3,429,806
Contingency		15%		$1,012,575	$514,471
Subtotal Contract Cost				$7,763,074	$3,944,276
Nourishment					
E&D+S&A		10%	1	$776,307	
1st Renourishment					
E&D+S&A		20%	1		$788,855
Total Construction Cost				$8,539,381	$4,733,132

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$8,539,381	$4,733,132
Interest During Construction	$42,619	$0
Total Investment Cost	$8,582,000	$4,733,132
Present Worth of Each Construction	$8,582,000	$2,319,189
Total Present Worth	$10,901,189	

Average Annual Cost	$1,016,267
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
1' Added Shoreline Width (ft) to R-74
Renourishment Interval: 13 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	522,852	$4,705,671	
	13	$9.00	251,075		$2,259,674
Beach Tilling (ac)		$300	0.5	$145	$145
Hard Bottom Mitigation (ac)		$300,000	4.1	$1,240,397	
Subtotal				$6,946,214	$3,259,819
Contingency		15%		$1,041,932	$488,973
Subtotal Contract Cost				$7,988,146	$3,748,792
Nourishment					
E&D+S&A		10%	1	$798,815	
1st Renourishment					
E&D+S&A		20%	1		$749,758
Total Construction Cost				$8,786,960	$4,498,551

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$8,786,960	$4,498,551
Interest During Construction	$43,855	$0
Total Investment Cost	$8,830,815	$4,498,551
Present Worth of Each Construction	$8,830,815	$2,077,029
Total Present Worth	$10,907,844	

Average Annual Cost	$1,016,888
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
20' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	830,009	$7,470,081	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	9.7	$2,908	$2,908
Hard Bottom Mitigation (ac)		$300,000	5.9	$1,768,281	
Subtotal				$10,241,270	$3,602,554
Contingency		15%		$1,536,190	$540,383
Subtotal Contract Cost				$11,777,460	$4,142,938
Nourishment					
E&D+S&A		10%	1	$1,177,746	
1st Renourishment					
E&D+S&A		20%	1		$828,588
Total Construction Cost				$12,955,206	$4,971,525

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$12,955,206	$4,971,525
Interest During Construction	$64,979	$0
Total Investment Cost	$13,020,186	$4,971,525
Present Worth of Each Construction	$13,020,186	$2,585,205
Total Present Worth	$15,605,390	

Average Annual Cost	$1,454,818
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
20' Added Shoreline Width (ft) to R-74
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	848,896	$7,640,067	
	12	$9.00	269,962		$2,429,660
Beach Tilling (ac)		$300	9.7	$2,908	$2,908
Hard Bottom Mitigation (ac)		$300,000	6.0	$1,805,256	
Subtotal				$10,448,230	$3,432,568
Contingency		15%		$1,567,235	$514,885
Subtotal Contract Cost				$12,015,465	$3,947,454
Nourishment					
E&D+S&A		10%	1	$1,201,547	
1st Renourishment					
E&D+S&A		20%	1		$789,491
Total Construction Cost				$13,217,012	$4,736,944

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$13,217,012	$4,736,944
Interest During Construction	$66,293	$0
Total Investment Cost	$13,283,304	$4,736,944
Present Worth of Each Construction	$13,283,304	$2,321,057
Total Present Worth	$15,604,361	

Average Annual Cost	$1,454,722
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
20' Added Shoreline Width (ft) to R-74
Renourishment Interval: 13 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	867,784	$7,810,053	
	13	$9.00	251,075		$2,259,674
Beach Tilling (ac)		$300	9.7	$2,908	$2,908
Hard Bottom Mitigation (ac)		$300,000	6.1	$1,842,230	
Subtotal				$10,655,191	$3,262,582
Contingency		15%		$1,598,279	$489,387
Subtotal Contract Cost				$12,253,470	$3,751,970
Nourishment					
E&D+S&A		10%	1	$1,225,347	
1st Renourishment					
E&D+S&A		20%	1		$750,394
Total Construction Cost				$13,478,817	$4,502,363

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$13,478,817	$4,502,363
Interest During Construction	$67,606	$0
Total Investment Cost	$13,546,422	$4,502,363
Present Worth of Each Construction	$13,546,422	$2,078,789
Total Present Worth	$15,625,211	

Average Annual Cost	$1,456,666
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 10 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	901,893	$8,117,037	
	10	$9.00	307,737		$2,769,633
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.4	$1,909,409	
Subtotal				$11,030,081	$3,773,268
Contingency		15%		$1,654,512	$565,990
Subtotal Contract Cost				$12,684,593	$4,339,258
Nourishment					
E&D+S&A		10%	1	$1,268,459	
1st Renourishment					
E&D+S&A		20%	1		$867,852
Total Construction Cost				$13,953,053	$5,207,109

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$13,953,053	$5,207,109
Interest During Construction	$70,332	$0
Total Investment Cost	$14,023,384	$5,207,109
Present Worth of Each Construction	$14,023,384	$2,873,556
Total Present Worth	$16,896,940	

Average Annual Cost	$1,575,223
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	920,780	$8,287,023	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.5	$1,953,293	
Subtotal				$11,243,951	$3,603,282
Contingency		15%		$1,686,593	$540,492
Subtotal Contract Cost				$12,930,544	$4,143,774
Nourishment					
E&D+S&A		10%	1	$1,293,054	
1st Renourishment					
E&D+S&A		20%	1		$828,755
Total Construction Cost				$14,223,598	$4,972,528

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$14,223,598	$4,972,528
Interest During Construction	$71,696	$0
Total Investment Cost	$14,295,294	$4,972,528
Present Worth of Each Construction	$14,295,294	$2,585,726
Total Present Worth	$16,881,020	

Average Annual Cost	$1,573,739
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	939,668	$8,457,009	
	12	$9.00	269,962		$2,429,660
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.7	$1,997,177	
Subtotal				$11,457,821	$3,433,295
Contingency		15%		$1,718,673	$514,994
Subtotal Contract Cost				$13,176,494	$3,948,290
Nourishment					
E&D+S&A		10%	1	$1,317,649	
1st Renourishment					
E&D+S&A		20%	1		$789,658
Total Construction Cost				$14,494,144	$4,737,948

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$14,494,144	$4,737,948
Interest During Construction	$73,059	$0
Total Investment Cost	$14,567,203	$4,737,948
Present Worth of Each Construction	$14,567,203	$2,321,549
Total Present Worth	$16,888,752	

Average Annual Cost	$1,574,460
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
50' Added Shoreline Width (ft) to R-74
Renourishment Interval: 9 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2011
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,336,863	$12,031,763	
	9	$9.00	326,624		$2,939,619
Beach Tilling (ac)		$300	24.2	$7,270	$7,270
Hard Bottom Mitigation (ac)		$300,000	10.1	$3,035,705	
Subtotal				$16,074,738	$3,946,889
Contingency		15%		$2,411,211	$592,033
Subtotal Contract Cost				$18,485,949	$4,538,922
Nourishment					
E&D+S&A		10%	1	$1,848,595	
1st Renourishment					
E&D+S&A		20%	1		$907,784
Total Construction Cost				$20,334,544	$5,446,707

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2011
Construction Cost	$20,334,544	$5,446,707
Interest During Construction	$103,007	$0
Total Investment Cost	$20,437,551	$5,446,707
Present Worth of Each Construction	$20,437,551	$3,189,882
Total Present Worth	$23,627,434	

Average Annual Cost	$2,202,676
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
50' Added Shoreline Width (ft) to R-74
Renourishment Interval: 10 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,355,750	$12,201,749	
	10	$9.00	307,737		$2,769,633
Beach Tilling (ac)		$300	24.2	$7,270	$7,270
Hard Bottom Mitigation (ac)		$300,000	10.4	$3,105,557	
Subtotal				$16,314,576	$3,776,903
Contingency		15%		$2,447,186	$566,535
Subtotal Contract Cost				$18,761,763	$4,343,438
Nourishment					
E&D+S&A		10%	1	$1,876,176	
1st Renourishment					
E&D+S&A		20%	1		$868,688
Total Construction Cost				$20,637,939	$5,212,126

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$20,637,939	$5,212,126
Interest During Construction	$104,544	$0
Total Investment Cost	$20,742,483	$5,212,126
Present Worth of Each Construction	$20,742,483	$2,876,324
Total Present Worth	$23,618,808	

Average Annual Cost	$2,201,872
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
50' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,374,637	$12,371,736	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	24.2	$7,270	$7,270
Hard Bottom Mitigation (ac)		$300,000	10.6	$3,181,335	
Subtotal				$16,560,341	$3,606,917
Contingency		15%		$2,484,051	$541,038
Subtotal Contract Cost				$19,044,392	$4,147,954
Nourishment					
E&D+S&A		10%	1	$1,904,439	
1st Renourishment					
E&D+S&A		20%	1		$829,591
Total Construction Cost				$20,948,831	$4,977,545

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$20,948,831	$4,977,545
Interest During Construction	$106,119	$0
Total Investment Cost	$21,054,951	$4,977,545
Present Worth of Each Construction	$21,054,951	$2,588,335
Total Present Worth	$23,643,285	

Average Annual Cost	$2,204,154
Interest Rate	6.125%

SUB-APPENDIX A-4

DETAILED COST ESTIMATES
FOR EVALUATION OF THE PROJECT LENGTH
OF THE MODIFICATION TO THE FEDERAL PROJECT

Sub-Apendix A-4

Modification to the Federal Project
Project Length Summary

Baseline Extension (ft)	South Project Limit	Nourishment Interval (yrs)	Annualized Costs
25	R-74	10	$1,575,000
25	R-74	11	**$1,574,000**
25	R-74	12	$1,574,000
25	R-79	11	$2,038,000
25	R-79	12	**$2,037,000**
25	R-79	13	$2,039,000
25	R-84	11	$2,232,000
25	R-84	12	**$2,231,000**
25	R-84	13	$2,231,000

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 10 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	901,893	$8,117,037	
	10	$9.00	307,737		$2,769,633
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.4	$1,909,409	
Subtotal				$11,030,081	$3,773,268
Contingency		15%		$1,654,512	$565,990
Subtotal Contract Cost				$12,684,593	$4,339,258
Nourishment					
E&D+S&A		10%	1	$1,268,459	
1st Renourishment					
E&D+S&A		20%	1		$867,852
Total Construction Cost				$13,953,053	$5,207,109

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$13,953,053	$5,207,109
Interest During Construction	$70,332	$0
Total Investment Cost	$14,023,384	$5,207,109
Present Worth of Each Construction	$14,023,384	$2,873,556
Total Present Worth	$16,896,940	

Average Annual Cost	$1,575,223
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	920,780	$8,287,023	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.5	$1,953,293	
Subtotal				$11,243,951	$3,603,282
Contingency		15%		$1,686,593	$540,492
Subtotal Contract Cost				$12,930,544	$4,143,774
Nourishment					
E&D+S&A		10%	1	$1,293,054	
1st Renourishment					
E&D+S&A		20%	1		$828,755
Total Construction Cost				$14,223,598	$4,972,528

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$14,223,598	$4,972,528
Interest During Construction	$71,696	$0
Total Investment Cost	$14,295,294	$4,972,528
Present Worth of Each Construction	$14,295,294	$2,585,726
Total Present Worth	$16,881,020	

Average Annual Cost	$1,573,739
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-74
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	939,668	$8,457,009	
	12	$9.00	269,962		$2,429,660
Beach Tilling (ac)		$300	12.1	$3,635	$3,635
Hard Bottom Mitigation (ac)		$300,000	6.7	$1,997,177	
Subtotal				$11,457,821	$3,433,295
Contingency		15%		$1,718,673	$514,994
Subtotal Contract Cost				$13,176,494	$3,948,290
Nourishment					
E&D+S&A		10%	1	$1,317,649	
1st Renourishment					
E&D+S&A		20%	1		$789,658
Total Construction Cost				$14,494,144	$4,737,948

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$14,494,144	$4,737,948
Interest During Construction	$73,059	$0
Total Investment Cost	$14,567,203	$4,737,948
Present Worth of Each Construction	$14,567,203	$2,321,549
Total Present Worth	$16,888,752	

Average Annual Cost	$1,574,460
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-79
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,074,451	$9,670,062	
	11	$9.00	328,330		$2,954,968
Beach Tilling (ac)		$300	15.2	$4,558	$4,558
Hard Bottom Mitigation (ac)		$300,000	14.3	$4,284,178	
Subtotal				$14,958,798	$3,959,527
Contingency		15%		$2,243,820	$593,929
Subtotal Contract Cost				$17,202,618	$4,553,456
Nourishment					
E&D+S&A		10%	1	$1,720,262	
1st Renourishment					
E&D+S&A		20%	1		$910,691
Total Construction Cost				$18,922,880	$5,464,147

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$18,922,880	$5,464,147
Interest During Construction	$95,383	$0
Total Investment Cost	$19,018,262	$5,464,147
Present Worth of Each Construction	$19,018,262	$2,841,369
Total Present Worth	$21,859,631	

Average Annual Cost	$2,037,872
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-79
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,093,339	$9,840,048	
	12	$9.00	309,442		$2,784,982
Beach Tilling (ac)		$300	15.2	$4,558	$4,558
Hard Bottom Mitigation (ac)		$300,000	14.4	$4,328,062	
Subtotal				$15,172,668	$3,789,540
Contingency		15%		$2,275,900	$568,431
Subtotal Contract Cost				$17,448,568	$4,357,972
Nourishment					
E&D+S&A		10%	1	$1,744,857	
1st Renourishment					
E&D+S&A		20%	1		$871,594
Total Construction Cost				$19,193,425	$5,229,566

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$19,193,425	$5,229,566
Interest During Construction	$96,746	$0
Total Investment Cost	$19,290,172	$5,229,566
Present Worth of Each Construction	$19,290,172	$2,562,437
Total Present Worth	$21,852,609	

Average Annual Cost	$2,037,217
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-79
Renourishment Interval: 13 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,112,226	$10,010,034	
	13	$9.00	290,555		$2,614,996
Beach Tilling (ac)		$300	15.2	$4,558	$4,558
Hard Bottom Mitigation (ac)		$300,000	14.6	$4,371,946	
Subtotal				$15,386,538	$3,619,554
Contingency		15%		$2,307,981	$542,933
Subtotal Contract Cost				$17,694,519	$4,162,487
Nourishment					
E&D+S&A		10%	1	$1,769,452	
1st Renourishment					
E&D+S&A		20%	1		$832,497
Total Construction Cost				$19,463,971	$4,994,985

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$19,463,971	$4,994,985
Interest During Construction	$98,110	$0
Total Investment Cost	$19,562,081	$4,994,985
Present Worth of Each Construction	$19,562,081	$2,306,238
Total Present Worth	$21,868,318	

Average Annual Cost	$2,038,682
Interest Rate	6.125%

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Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-84
Renourishment Interval: 11 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,207,079	$10,863,707	
	11	$9.00	362,570		$3,263,132
Beach Tilling (ac)		$300	17.8	$5,350	$5,350
Hard Bottom Mitigation (ac)		$300,000	15.2	$4,556,664	
Subtotal				$16,425,721	$4,268,483
Contingency		15%		$2,463,858	$640,272
Subtotal Contract Cost				$18,889,579	$4,908,755
Nourishment					
E&D+S&A		10%	1	$1,888,958	
1st Renourishment					
E&D+S&A		20%	1		$981,751
Total Construction Cost				$20,778,537	$5,890,506

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$20,778,537	$5,890,506
Interest During Construction	$105,257	$0
Total Investment Cost	$20,883,794	$5,890,506
Present Worth of Each Construction	$20,883,794	$3,063,077
Total Present Worth	$23,946,871	

Average Annual Cost	$2,232,456
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-84
Renourishment Interval: 12 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,226,019	$11,034,170	
	12	$9.00	343,630		$3,092,670
Beach Tilling (ac)		$300	17.8	$5,350	$5,350
Hard Bottom Mitigation (ac)		$300,000	15.3	$4,600,548	
Subtotal				$16,640,068	$4,098,020
Contingency		15%		$2,496,010	$614,703
Subtotal Contract Cost				$19,136,078	$4,712,723
Nourishment					
E&D+S&A		10%	1	$1,913,608	
1st Renourishment					
E&D+S&A		20%	1		$942,545
Total Construction Cost				$21,049,686	$5,655,267

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$21,049,686	$5,655,267
Interest During Construction	$106,630	$0
Total Investment Cost	$21,156,316	$5,655,267
Present Worth of Each Construction	$21,156,316	$2,771,027
Total Present Worth	$23,927,343	

Average Annual Cost	$2,230,635
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Ft Lauderdale
25' Added Shoreline Width (ft) to R-84
Renourishment Interval: 13 yrs
Project Life: 18 years

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 3 Beach Fill (cy)	0	$9.00	1,244,959	$11,204,633	
	13	$9.00	324,690		$2,922,207
Beach Tilling (ac)		$300	17.8	$5,350	$5,350
Hard Bottom Mitigation (ac)		$300,000	15.5	$4,644,432	
Subtotal				$16,854,415	$3,927,557
Contingency		15%		$2,528,162	$589,134
Subtotal Contract Cost				$19,382,577	$4,516,690
Nourishment					
E&D+S&A		10%	1	$1,938,258	
1st Renourishment					
E&D+S&A		20%	1		$903,338
Total Construction Cost				$21,320,835	$5,420,029

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$21,320,835	$5,420,029
Interest During Construction	$108,004	$0
Total Investment Cost	$21,428,838	$5,420,029
Present Worth of Each Construction	$21,428,838	$2,502,485
Total Present Worth	$23,931,323	

Average Annual Cost	$2,231,006
Interest Rate	6.125%

SUB-APPENDIX A-5

DETAILED COST ESTIMATES
USED FOR DETERMINING THE OPTIMAL RENOURISHMENT INTERVAL
OF THE IMPLEMENTATION OF THE FEDERAL PROJECT

Sub-Apendix A-5

Implementation of the Reevaluated Federal Project
Interval Optimization Summary

Segment II
Pompano Beach to
Fort Lauderdale

Nourishment Interval (years)	Project Costs
9	$2,356,000
10	**$2,355,000**
11	$2,358,000
12	$2,364,000
13	$2,373,000
14	$2,385,000
15	$2,400,000

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 9 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2011
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	342,840	$2,914,143	
	9	$8.50	225,703		$1,918,477
Reach 3 Beach Fill (cy)	0	$9.00	883,006	$7,947,051	
	9	$9.00	326,624		$2,939,619
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	12.4	$3,713,277	
Subtotal				$15,683,437	$5,967,062
Contingency		15%		$2,352,516	$895,059
Subtotal Contract Cost				$18,035,953	$6,862,121
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$20,093,032	$8,669,200

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2011
Construction Cost	$20,093,032	$8,669,200
Interest During Construction	$101,784	$0
Total Investment Cost	$20,194,816	$8,669,200
Present Worth of Each Construction	$20,194,816	$5,077,146
Total Present Worth	$25,271,962	

Average Annual Cost	$2,355,988
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 10 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	356,088	$3,026,746	
	10	$8.50	212,456		$1,805,873
Reach 3 Beach Fill (cy)	0	$9.00	901,893	$8,117,037	
	10	$9.00	307,737		$2,769,633
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	12.8	$3,829,062	
Subtotal				$16,081,811	$5,684,472
Contingency		15%		$2,412,272	$852,671
Subtotal Contract Cost				$18,494,083	$6,537,143
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$20,551,162	$8,344,222

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$20,551,162	$8,344,222
Interest During Construction	$104,105	$0
Total Investment Cost	$20,655,267	$8,344,222
Present Worth of Each Construction	$20,655,267	$4,604,779
Total Present Worth	$25,260,046	

Average Annual Cost	$2,354,877
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 11 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	369,335	$3,139,349	
	11	$8.50	199,208		$1,693,270
Reach 3 Beach Fill (cy)	0	$9.00	920,780	$8,287,023	
	11	$9.00	288,850		$2,599,646
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	13.2	$3,949,445	
Subtotal				$16,484,784	$5,401,883
Contingency		15%		$2,472,718	$810,282
Subtotal Contract Cost				$18,957,502	$6,212,165
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$21,014,581	$8,019,244

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$21,014,581	$8,019,244
Interest During Construction	$106,452	$0
Total Investment Cost	$21,121,033	$8,019,244
Present Worth of Each Construction	$21,121,033	$4,170,026
Total Present Worth	$25,291,059	

Average Annual Cost	$2,357,768
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 12 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	382,583	$3,251,953	
	12	$8.50	185,961		$1,580,667
Reach 3 Beach Fill (cy)	0	$9.00	939,668	$8,457,009	
	12	$9.00	269,962		$2,429,660
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	13.6	$4,069,829	
Subtotal				$16,887,757	$5,119,294
Contingency		15%		$2,533,164	$767,894
Subtotal Contract Cost				$19,420,921	$5,887,188
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$21,478,000	$7,694,267

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$21,478,000	$7,694,267
Interest During Construction	$108,800	$0
Total Investment Cost	$21,586,800	$7,694,267
Present Worth of Each Construction	$21,586,800	$3,770,117
Total Present Worth	$25,356,917	

Average Annual Cost	$2,363,908
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 13 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	395,830	$3,364,556	
	13	$8.50	172,713		$1,468,064
Reach 3 Beach Fill (cy)	0	$9.00	958,555	$8,626,995	
	13	$9.00	251,075		$2,259,674
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	14.0	$4,190,213	
Subtotal				$17,290,731	$4,836,704
Contingency		15%		$2,593,610	$725,506
Subtotal Contract Cost				$19,884,340	$5,562,210
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$21,941,419	$7,369,289

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$21,941,419	$7,369,289
Interest During Construction	$111,147	$0
Total Investment Cost	$22,052,566	$7,369,289
Present Worth of Each Construction	$22,052,566	$3,402,479
Total Present Worth	$25,455,045	

Average Annual Cost	$2,373,056
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 14 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2016
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	409,078	$3,477,159	
	14	$8.50	159,466		$1,355,461
Reach 3 Beach Fill (cy)	0	$9.00	977,442	$8,796,982	
	14	$9.00	232,188		$2,089,688
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	14.4	$4,310,597	
Subtotal				$17,693,704	$4,554,115
Contingency		15%		$2,654,056	$683,117
Subtotal Contract Cost				$20,347,759	$5,237,232
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$22,404,838	$7,044,311

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2016
Construction Cost	$22,404,838	$7,044,311
Interest During Construction	$113,495	$0
Total Investment Cost	$22,518,333	$7,044,311
Present Worth of Each Construction	$22,518,333	$3,064,719
Total Present Worth	$25,583,052	

Average Annual Cost	$2,384,989
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Segment II
100'/25' Added Shoreline Width (ft)
Renourishment Interval: 15 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2017
Mobilization		$1,100,000	1	$1,100,000	$1,100,000
Reach 2 Beach Fill (cy)	0	$8.50	422,325	$3,589,762	
	15	$8.50	146,219		$1,242,857
Reach 3 Beach Fill (cy)	0	$9.00	996,330	$8,966,968	
	15	$9.00	213,300		$1,919,702
Beach Tilling (ac)		$300	29.9	$8,966	$8,966
Hard Bottom Mitigation (ac)		$300,000	14.8	$4,430,981	
Subtotal				$18,096,677	$4,271,526
Contingency		15%		$2,714,502	$640,729
Subtotal Contract Cost				$20,811,178	$4,912,254
Geotechnical Investigations		190,000	1	$190,000	$190,000
Secure Easements		250,000	1	$250,000	
Environmental Monitoring		275,079	1	$275,079	$275,079
E&D+S&A		1,342,000	1	$1,342,000	$1,342,000
Total Construction Cost				$22,868,257	$6,719,333

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2017
Construction Cost	$22,868,257	$6,719,333
Interest During Construction	$115,842	$0
Total Investment Cost	$22,984,100	$6,719,333
Present Worth of Each Construction	$22,984,100	$2,754,613
Total Present Worth	$25,738,713	

Average Annual Cost	$2,399,501
Interest Rate	6.125%

Implementation of the Reevaluated Federal Project

Interval Optimization Summary

Pompano Beach to
Lauderdale-by-the-Sea

Nourishment Interval (years)	Project Costs
9	$967,000
10	**$967,000**
11	$969,000
12	$972,000
13	$976,000
14	$981,000
15	$988,000

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 9 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2011
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	342,840	$2,914,143	
	9	$8.50	225,703		$1,918,477
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	6.1	$1,843,153	
Subtotal				$5,762,627	$2,923,808
Contingency		15%		$864,394	$438,571
Subtotal Contract Cost				$6,627,021	$3,362,379
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$7,771,624	$4,381,982

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2011
Construction Cost	$7,771,624	$4,381,982
Interest During Construction	$38,787	$0
Total Investment Cost	$7,810,411	$4,381,982
Present Worth of Each Construction	$7,810,411	$2,566,323
Total Present Worth	$10,376,734	

Average Annual Cost	$967,375
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 10 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2012
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	356,088	$3,026,746	
	10	$8.50	212,456		$1,805,873
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	6.4	$1,919,653	
Subtotal				$5,951,730	$2,811,205
Contingency		15%		$892,760	$421,681
Subtotal Contract Cost				$6,844,490	$3,232,885
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$7,989,093	$4,252,488

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2012
Construction Cost	$7,989,093	$4,252,488
Interest During Construction	$39,873	$0
Total Investment Cost	$8,028,965	$4,252,488
Present Worth of Each Construction	$8,028,965	$2,346,746
Total Present Worth	$10,375,711	

Average Annual Cost	$967,279
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 11 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2013
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	369,335	$3,139,349	
	11	$8.50	199,208		$1,693,270
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	6.7	$1,996,153	
Subtotal				$6,140,833	$2,698,602
Contingency		15%		$921,125	$404,790
Subtotal Contract Cost				$7,061,958	$3,103,392
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$8,206,561	$4,122,995

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2013
Construction Cost	$8,206,561	$4,122,995
Interest During Construction	$40,958	$0
Total Investment Cost	$8,247,519	$4,122,995
Present Worth of Each Construction	$8,247,519	$2,143,967
Total Present Worth	$10,391,486	

Average Annual Cost	$968,750
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 12 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2014
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	382,583	$3,251,953	
	12	$8.50	185,961		$1,580,667
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	6.9	$2,072,653	
Subtotal				$6,329,936	$2,585,998
Contingency		15%		$949,490	$387,900
Subtotal Contract Cost				$7,279,427	$2,973,898
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$8,424,030	$3,993,501

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2014
Construction Cost	$8,424,030	$3,993,501
Interest During Construction	$42,044	$0
Total Investment Cost	$8,466,073	$3,993,501
Present Worth of Each Construction	$8,466,073	$1,956,777
Total Present Worth	$10,422,851	

Average Annual Cost	$971,674
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 13 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2015
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	395,830	$3,364,556	
	13	$8.50	172,713		$1,468,064
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	7.2	$2,149,153	
Subtotal				$6,519,040	$2,473,395
Contingency		15%		$977,856	$371,009
Subtotal Contract Cost				$7,496,896	$2,844,404
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$8,641,499	$3,864,007

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2015
Construction Cost	$8,641,499	$3,864,007
Interest During Construction	$43,129	$0
Total Investment Cost	$8,684,627	$3,864,007
Present Worth of Each Construction	$8,684,627	$1,784,053
Total Present Worth	$10,468,681	

Average Annual Cost	$975,946
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 14 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2016
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	409,078	$3,477,159	
	14	$8.50	159,466		$1,355,461
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	7.4	$2,225,653	
Subtotal				$6,708,143	$2,360,792
Contingency		15%		$1,006,221	$354,119
Subtotal Contract Cost				$7,714,364	$2,714,911
Geotechnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$8,858,967	$3,734,514

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2016
Construction Cost	$8,858,967	$3,734,514
Interest During Construction	$44,214	$0
Total Investment Cost	$8,903,182	$3,734,514
Present Worth of Each Construction	$8,903,182	$1,624,749
Total Present Worth	$10,527,930	

Average Annual Cost	$981,470
Interest Rate	6.125%

Estimate of Contract and Construction Costs
Pompano Beach to Lauderdale-by-the-Sea
100' Added Shoreline Width (ft)
Renourishment Interval: 15 yrs
Project Life: 18 yrs

Item	Project Year	Unit Cost	Quantity	Renourishment at Indicated Year 2002	2017
Mobilization		$1,000,000	1	$1,000,000	$1,000,000
Reach 2 Beach Fill (cy)	0	$8.50	422,325	$3,589,762	
	15	$8.50	146,219		$1,242,857
Beach Tilling (ac)		$300	17.8	$5,331	$5,331
Hard Bottom Mitigation (ac)		$300,000	7.7	$2,302,152	
Subtotal				$6,897,246	$2,248,189
Contingency		15%		$1,034,587	$337,228
Subtotal Contract Cost				$7,931,833	$2,585,417
Geotecnnical Investigations		107,203	1	$107,203	$107,203
Secure Easements		125,000	1	$125,000	
Environmental Monitoring		155,207	1	$155,207	$155,207
E&D+S&A		757,193	1	$757,193	$757,193
Total Construction Cost				$9,076,436	$3,605,020

Summary-Investment and Annual Costs

Item	Renourishment at Indicated Year 2002	2017
Construction Cost	$9,076,436	$3,605,020
Interest During Construction	$45,300	$0
Total Investment Cost	$9,121,736	$3,605,020
Present Worth of Each Construction	$9,121,736	$1,477,890
Total Present Worth	$10,599,626	

Average Annual Cost	$988,154
Interest Rate	6.125%